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ABSTRACT

Presented is a teacher's guide from the Elementary Science Study offering suggested mapping activities. This guide is organized into four general sections: (1) Finding a Place: (2) Finding Your Way: (3) Looking at Scale: and (4) Outdoor Mapping. Each section suggests activities for several lessons: materials and questions are listed for each activity. (Author/DS)

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ED196675

teacher's guide for

mapping

Elementary Science Study

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SE 033 231

The Mapping Unit
Teacher's Guide for Mapping
Making Maps
Mapping Games
Class Kit for Mapping

Related Units
Attribute Games and Problems
Daytime Astronomy
Geo Blocks
Light and Shadows
Match and Measure
Mirror Cards
Pattern Blocks
Stream Tables
Tangrams

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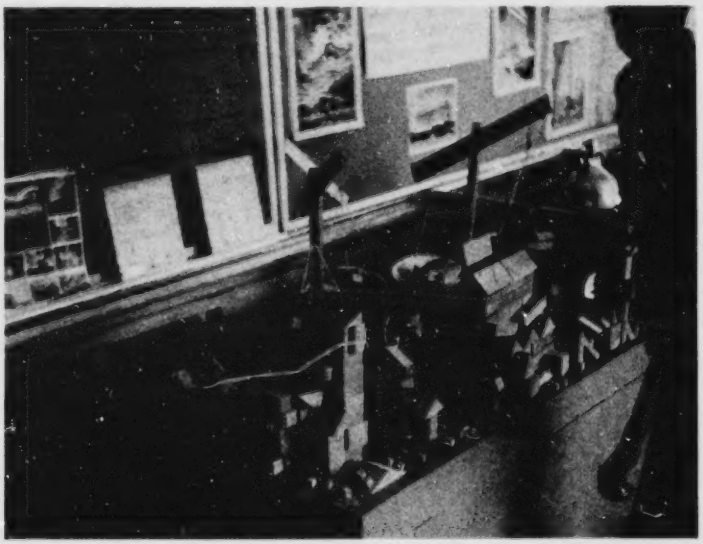
preface

The Elementary Science Study is one of many curriculum development programs in the fields of science, social studies, and mathematics under preparation at Education Development Center, Inc. EDC (a private nonprofit organization, incorporating the Institute for Educational Innovation and Educational Services Incorporated) began in 1958 to develop new ideas and methods for improving the content and process of education.

ESS has been supported primarily by grants from the National Science Foundation. Development of materials for teaching science from kindergarten through eighth grade started on a small scale in 1960. The work of the project has since involved more than a hundred educators in the conception and design of the units of study. Among the staff have been scientists, engineers, mathematicians, and teachers experienced in working with students of all ages, from kindergarten through college.

Equipment, films, and printed materials are produced with the help of staff specialists, as well as of the film and photography studios, the design laboratory, and the production shops of EDC. At every stage of development, ideas and materials are taken into actual classrooms, where children shape the form and content of each unit before it is released to schools everywhere.



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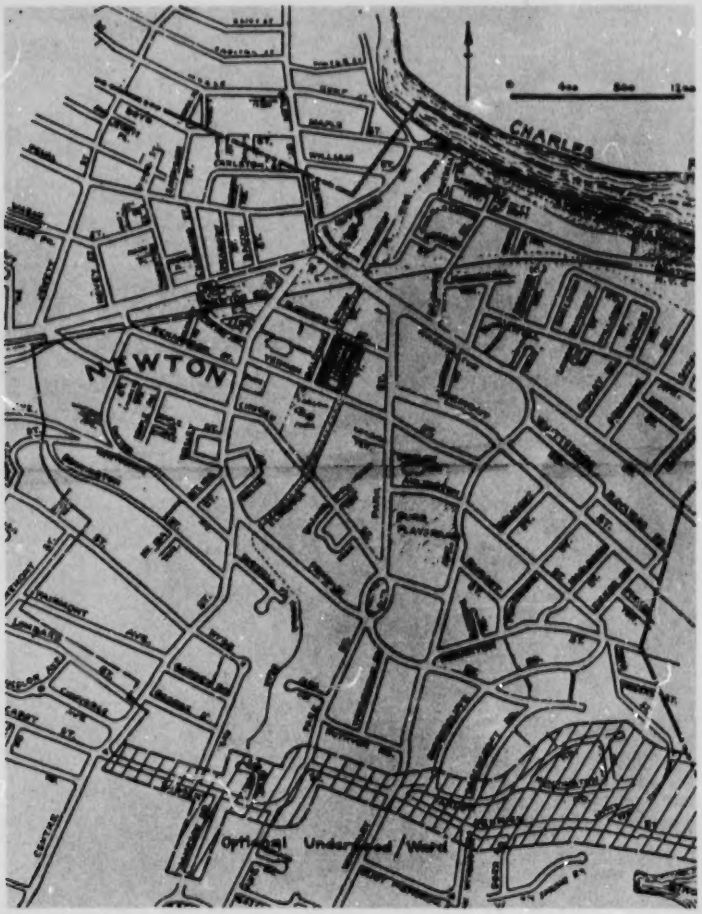

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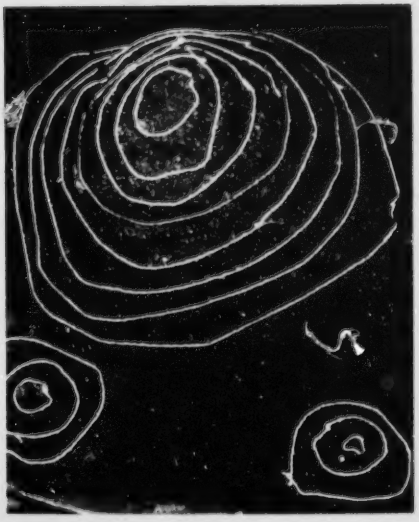
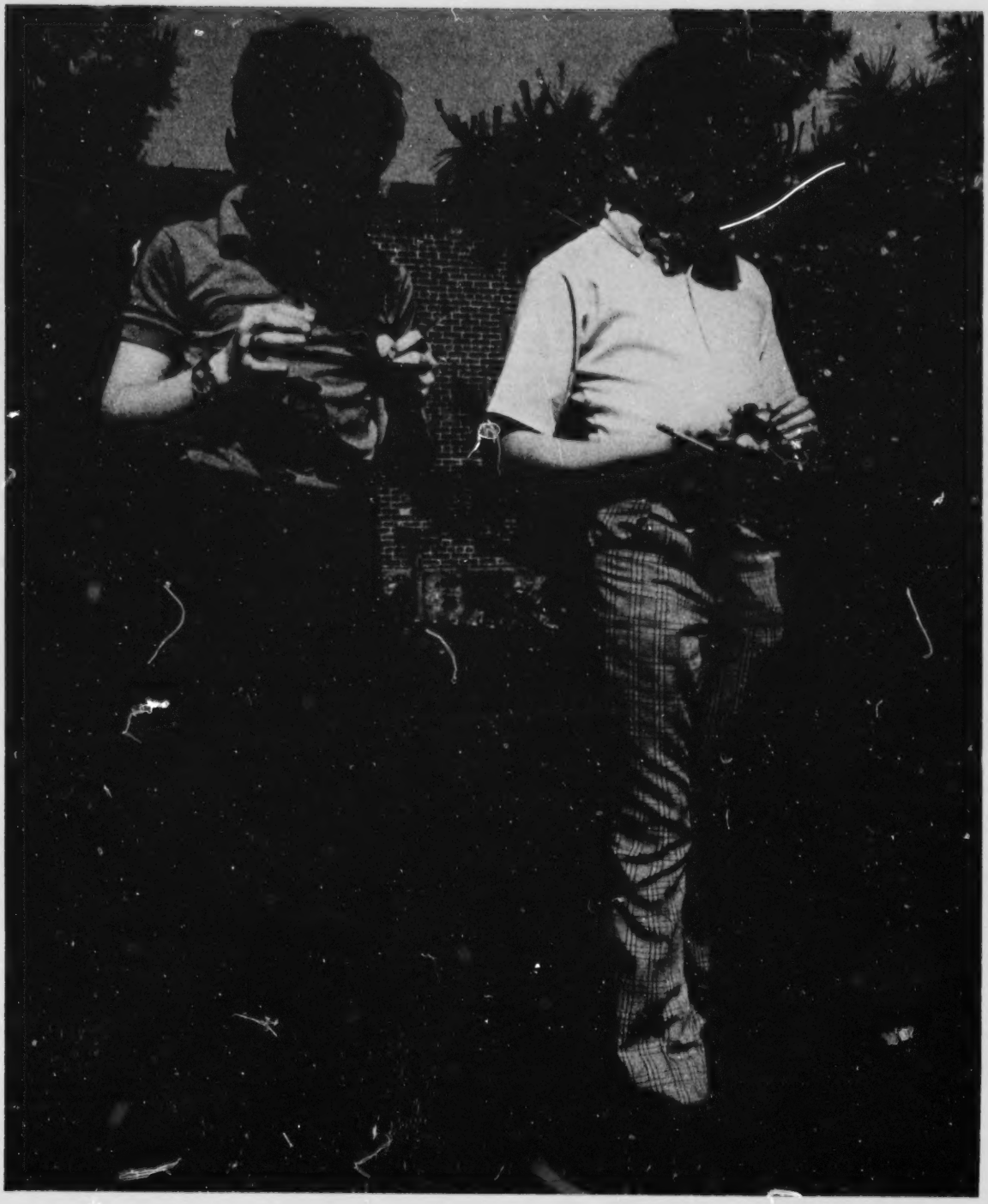




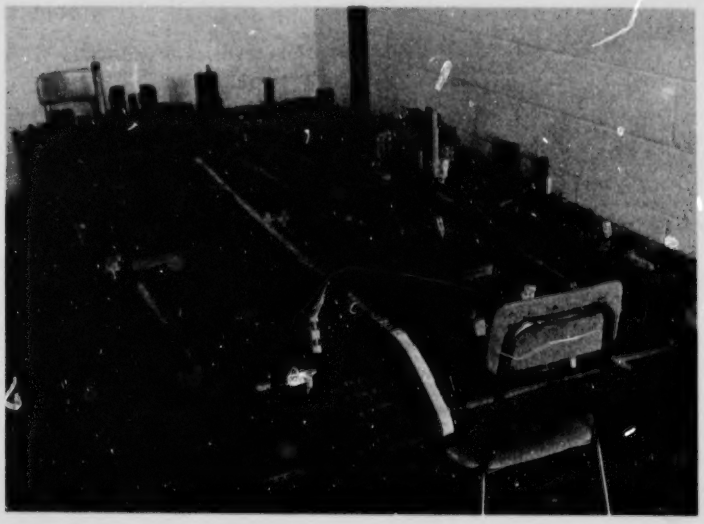
introduction

what is a map?

Maps are found—as you might expect—in atlases and filling stations. But there are other things that can properly be called maps, and these are found everywhere you look. A genealogical table is a kind of map; a photograph is, too. So is the blueprint for a house, a graph, a theater seating plan, a printed word, or a mathematics equation. A map is any symbolic representation. It is a pattern, a guide, a description. It can take many forms, and it can be of almost anything.

Whatever the form it takes, a map is primarily a means of transmitting information. It can record a sequence of events, describe a physical location, or give a series of instructions.

In school, children are usually taught how to read and use maps just by reading and using maps. Maps, however, are abstractions of complex data and express a great deal of material in symbolic form. In this unit, rather than just using the symbols and explaining their meaning, children have the opportunity to explore the actual things for which symbols are used on maps. They create their own codes as well as learn conventional systems for gathering, communicating, and representing information. They share in a wide range of activities, in which they move back and forth between concrete three-dimensional experiences and representations of those experiences.



activities

Many of the activities suggested in the unit take place out-of-doors. The children go on treasure hunts; make diagrams of the school grounds; locate, measure, and draw land features; create models from actual landscapes; and survey areas for making maps.

In the *Guide*, the activities are organized around fundamental questions that have arisen repeatedly in trial classes.

How do you describe things to someone else who can't see what you can?

How do you make a map that someone else can follow?

How do you show on a flat piece of paper what you see around you?

How do you draw things the right size?

These questions involve such tasks as representing shape and size consistently, describing position and defining orientation, creating and reading symbols, assessing proportions, devising appropriate scales, and transposing measurements of distance and elevation.

Activities other than those suggested in the *Guide* may be more appropriate for your class. Children's activities during playtime may give you clues as to what kinds of mapping projects they will profit from most. The ideas on pages 12-18 may be helpful, also.

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mapping games

In order to help children explore mapping ideas in a variety of ways, the unit includes a series of *Mapping Games* on separate cards. These are primarily for individuals and small groups but can also be used as a supplement to large-group map-making projects.

In the *Mapping Games,* children work with concrete materials, such as blocks, puzzles, checkerboards, and three-dimensional graphs. Designing mazes on geoboards may help some children learn to estimate scale or assess area. Inventing codes for giving directions or keeping track of the movements of a three-dimensional tic-tac-toe game may help others develop a sense for the usefulness of symbols. Predicting shadow shapes, tracing projected outlines, and matching diagrams or photographs with real objects can all lead children to understand that there are direct relationships

between concrete objects and the two-dimensional symbols for those objects—that maps are rooted in and grow out of a three-dimensional world.

Although the games can be played in any sequence and at any time, some games seem to go well with certain of the activities suggested in this *Guide*. They are listed at the end of each section (see pages 3*, 46, and 59).

Many of the materials suggested in the *Mapping Games* will be familiar to the children, although they may not regard them as *school* materials. It is likely that children will benefit from playing with the materials before they go on to play the games. As they proceed, most will become accustomed to the games approach to mapping. Children will think of new ways to use the materials and will bring in new materials for *Mapping Games*.

ages and scheduling

Ideally, children in every grade should have some experience with making and reading maps. In this unit, there are suggestions which can be adapted for all ages. Taken as a whole, the unit is probably most appropriate for use with students in grades five through seven. It can, however, be adapted easily for junior high school students and even for older students. Some of the mapping projects suggested under "General Ideas for Mapping" are appropriate for children in primary grades (see pages 12-18).

Since MAPPING is designed to be used as a resource of ideas rather than as a series of consecutive activities, one class's mapping project might last a week and another's might last several months. Several classes have worked on the *Mapping Games* on and off for most of the school year.

using the guide

Since the activities in the *Guide* are offered as suggestions for you to select among, you will probably find it helpful to read through the entire *Guide* before you begin to teach MAPPING. It is organized into four general sections: "Finding a Place," "Finding Your Way," "Looking at Scale," and "Outdoor Mapping." Each suggests activities for several lessons. Materials are listed for each activity, and questions that trial teachers have used to stimulate exploration are offered. Children's own words are used to indicate questions and problems that may come up and ways to handle them. Related *Mapping Games* are grouped together at the end of each section, except the section on "Outdoor Mapping."

The booklet *Making Maps* shows a series of MAPPING activities as one class did them. It may give you some ideas about how you want to teach. Teachers have also found it useful to have copies of *Making Maps* around the classroom for students to refer to.

setting up

It may be helpful to find a location in the classroom where the cards and the equipment for the *Mapping Games* can be placed. You may want to put out only those games which seem to correlate with specific mapping projects. Or, you may feel that the children themselves are capable of selecting appropriate games from the whole range provided in the list. (There are not, however, enough materials in the *Class Kit* to have everyone playing the same games at the same time.)

Teachers have also found it very helpful to provide a place for sand and block play, since, if these materials are easily accessible, they can be used profitably throughout the unit.

starting out

MAPPING can begin by children trying some activity suggested in the *Guide*, or it may start spontaneously from questions pertaining to mapping that arise in other contexts. "General Ideas for Mapping" (pages 12-18) offers some ideas around which mapping activities might be built. Perhaps your students are already engaged in these or similar activities which might serve as a focus for mapping projects.

There is no reason why the unit should progress in the same way in any two classrooms. Ideally, the activities should come from the children's own suggestions, questions, and ideas. As MAPPING goes on, therefore, the classroom is likely to look more and more like a three-ring circus, with many different activities progressing simultaneously.

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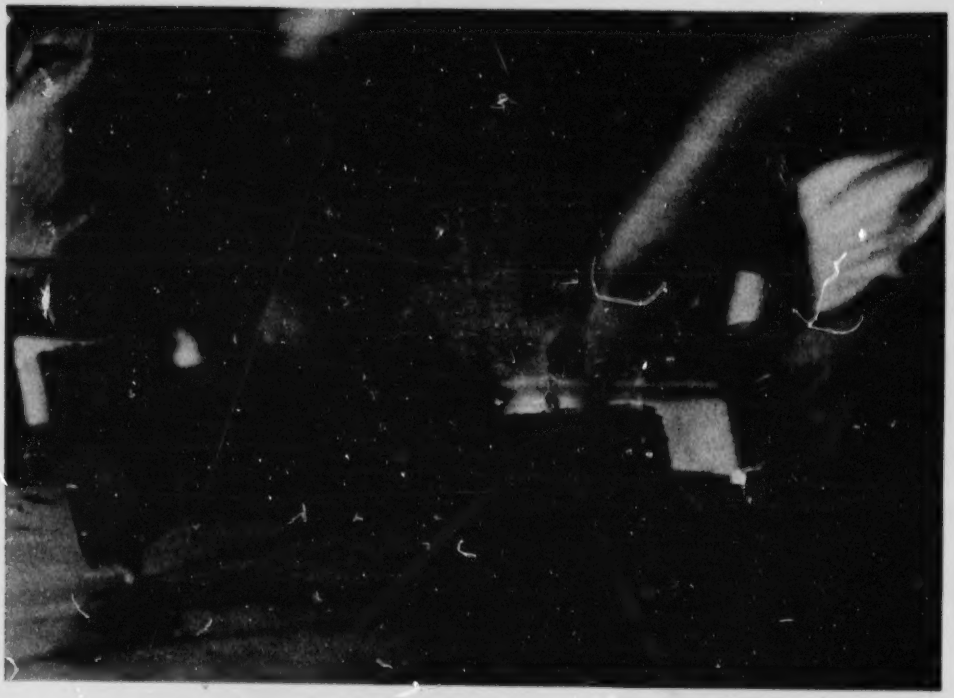
The following glimpses of what a few classrooms have tried will illustrate that MAPPING can evolve in many different ways.

In one fourth grade class, some children were interested in miniature cars and trucks. The teacher brought in scraps of wood, dowels, cardboard, construction paper, and hammers. (Nails were made from small scraps of wood.) She divided the class into groups and gave each group a large piece of cardboard on which to build their portion of an imaginary city for their vehicles.

The problems of scale, proportion, point of view, and distance became evident as the models grew more complex. The children stopped to raise many questions: How could they get their cars from one group's part of town to another's? How big should they make the roads so that their trucks could pass? How tall should a bridge be if a truck is 2 inches high? Does the policeman really lie down when he directs traffic? If one group uses red for highways, should other groups use red, too?



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They tried to tackle the many problems which arose when separate groups found they needed ways to coordinate and communicate their information with one another. The teacher allowed the major activity of building the model to go on for several weeks. She introduced supplemental activities and appropriate *Mapping Games* to groups of children as they became genuinely interested in solving a particular difficulty.

In another class, a group of older children spent a week at a camp in the mountains. They became interested in the erosion caused by a stream in the area. They wanted to build a model of the stream on a sand table in their classroom. This large project gave rise to many problems in noting landmarks, scaling, surveying, and transposing distances and elevations from one medium to another.

A third class, in their study of the westward movement, wanted to build a large-scale replica of a frontier town. They had many pictures and models from which to gather data about the size and placement of buildings and landmarks. With brown wrapping paper, cardboard, and some bricks they made from sod, they constructed a replica of part of the town. As they proceeded, they confronted many problems of orientation, viewpoint, and scale.

In each of these cases, specific mapping skills were introduced as problems arose and as children saw a need to understand and use them.

The following list of suggestions may give you other ideas for mapping projects suitable for your class. For a pictorial record of one sixth grade's activities, see the booklet *Making Maps.*

general ideas for mapping

large constructions

for young children

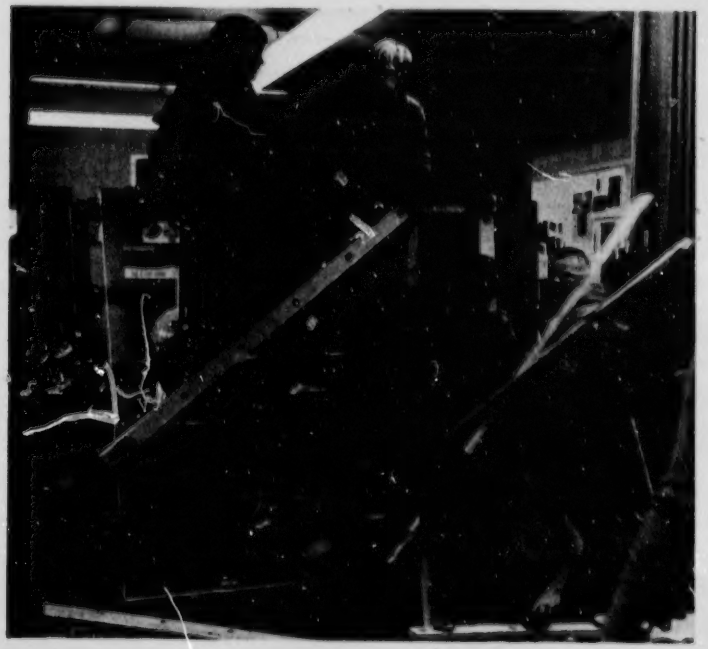
stores
houses
businesses
any structures that can be modified
mazes (life-size)

possible materials

blocks
shoe-box bricks
paste for mortar
large cardboard or paper pieces for roofs and walls
boards, dowels, broomsticks for beams or frames

for older children

replica of a dwelling for dramatic play connected with social studies project
set for a play
a real building
tree house

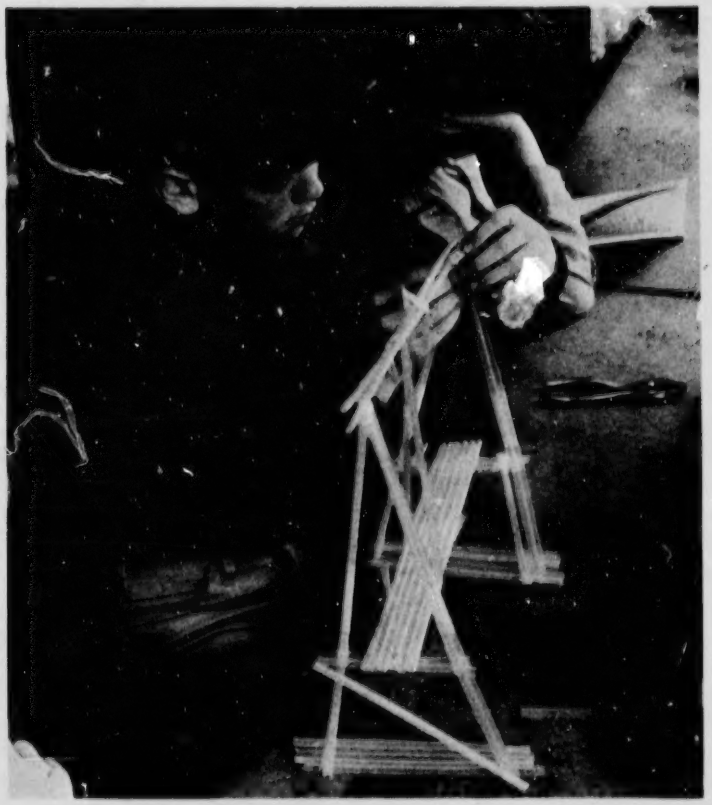


possible materials
two-by-fours
boards
nails (and hammers)
cardboard sheets and cylinders
scrap lumber
plastic sheeting

scale models

construction*
bridges
towers
buildings
boats
planes
cars
modern and historic machines

*See the Elementary Science Study unit STRUCTURES.



possible materials
straws
pins
modeling clay
paper
blocks
papier-mâché
pegboard
screws, nuts, and bolts
Lego
Tinkertoy
pulleys

dioramas and shadow boxes
scenes from history
underwater scenes
foreign places
book illustrations
imaginary lands

possible materials
shoe boxes, other boxes (line with dark paper)
paper of a variety of textures and colors
crayons, paints, chalk
cloth
sand, shells, wood scraps

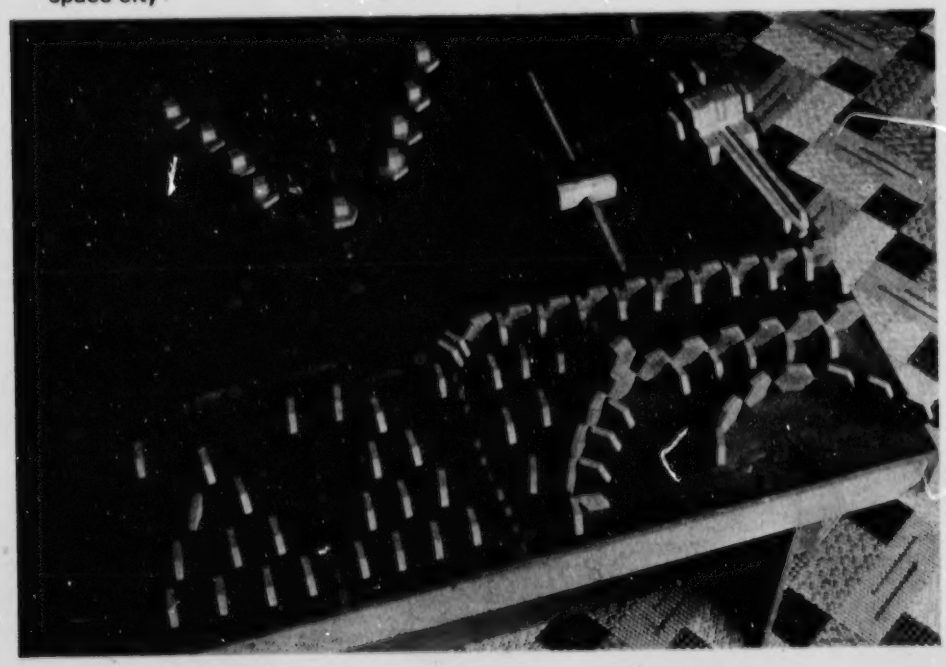
plants
paste
batteries, bulbs, wire (for lighting up scene from behind)

table models
Note: These can include many buildings or a building with many rooms.

historic places
Roman forum
Indian village
medieval manor
colonial seaport

local places
a street
your town
a farm
the school
the airport
a harbor

imaginary places
an island
fairyland
space city



possible materials

large work surface (to draw on, pin or glue things to) — cardboard sheet, table, flat box, sheet, or paper
colored string, yarn
scraps of wood, cardboard
spools, blocks
tiny boxes
sticks, moss, felt or other cloth
colored paper
felt-tip pens, crayons, paints, chalk
toy cars, trucks, planes, animals, people
pieces of wooden dowel for use as nails in cardboard

large three-dimensional subjects

land features
mountains
rivers
volcanoes
geysers
faults
deserts
islands

mockups
designs for a playground
space travels
parts of the solar system

possible materials
papier-mâché
sand
water
string
sticks
scrap materials

outdoor activities

explore a mile
Go for a walk. Draw the path of your walk on a piece of paper, and cut it out.
Time how long it takes to walk a mile.
Draw the symbols to indicate what you see.
Decide on a scale, for example, 1" = 100'.
Make every turn match the direction and angle that you follow as you walk.
Compare what you see on a bicycle to what you see when you walk.

take a series of photographs on a walk or a field trip
Have someone else look at them and tell where he would go to retrace your trip.
Write stories, poems, or riddles that tell about different parts of your trip. Can someone else tell where you've been from what you've written?

photograph buildings and sites in your neighborhood
Build or draw a map around the pictures, putting them on the streets where they belong.

watch the weather
Make up symbols for different weather conditions.
Read weather maps.
Chart or map weather patterns for a day, a week, a month.

map wind direction in the schoolyard
Make a 3-D map like the temperature map described on pages 58-59.

make contour maps
Show the distribution of plants, shrubs, and trees in an area.
Show the leaf concentrations (on the ground) in a backyard.
Map the population concentration in your neighborhood.

Map the houses in your neighborhood by size.
Map the number of vehicles on your road at different times of the day.

make horizon maps
Map buildings and trees silhouetted against the sky.
Map the sky.*

possible materials
paper
pencils
odometer
watch
scissors
compass
camera
film

*See the Elementary Science Study units WHERE IS THE MOON and DAYTIME ASTRONOMY.

mapping materials

lass kit*

3	graph paper pads (3 sizes of squares)
25	clear acetate sheets
10	grease pencils
5	felt-tip pens
300	6" x 8" unlined index cards
6	15" x 15" geoboard
1	25" x 25" geoboard
300	colored rubber bands
10 lb	modeling clay
10	assorted directional compasses
5	30" x 30" sheets of 3 mil plastic (for lining cardboard boxes)
2	clear plastic shoe boxes with plain, transparent lids
2	balls cotton string
1	skein heavy dark-colored yarn
6	screw eyes
3	test tubes
6	2" angle braces with screws
24	probe sticks
5	thermometers
4	measuring wheels

to order separately*

1 or 2 sets pieces for *Attribute Games and Problems*
1 or 2 sets *Tangram Pieces*
1 set *Geo Blocks*
1 set *Problem Cards for Geo Blocks*

to buy

1 set flat Play Plax (48 pieces)
1 3-D Tic-Tac-Toe or Qubic
2 checkerboards (can be made)
2 sets checkers (can be made)

to collect

paper — all sizes
colored construction paper (small amount)
pencils

*Available from Webster Division, McGraw-Hill Book Company, Manchester Road, Manchester, Missouri 63011.

crayons
scissors
Polaroid camera and film
cellophane tape
masking tape
rulers
saw
screwdriver
yardsticks
2 buckets
3 heavy cardboard boxes (about 16" x 20" x 5"; you can cut these down from bigger boxes), large plastic wading pans, or a sand table
10 wire coat hangers
3 hinged cardboard screens, large books, or other table-top dividers to stand between players
2 1" x 2" x 6' lengths soft wood (paint alternate colors every foot)
3 1" x 1" x 5' lengths soft wood (for levels)
1 bag Sakrete Play Sand (80 lb)
1 light source (gooseneck lamp or high-intensity lamp)
overhead and/or opaque projector
assortment of wooden blocks
collection of small objects — miniature cars, trucks, trains, figurines, model animals, trees, chalk, tacks
collection of maps — local road maps, town maps, relief maps, other maps

Write: U.S. Geological Survey
Washington, D.C. 20242
Ask for: State index map for your state
Find: Name and number of section
Order: Topographic map and/or aerial map of your section

other ESS units related to Mapping*

Attribute Games and Problems
Daytime Astronomy
Geo Blocks
Light and Shadows
Match and Measure
Mirror Cards
Pattern Blocks
Stream Tables
Tangrams

*Available from Webster Division, McGraw-Hill Book Company, Manchester Road, Manchester, Missouri 63011.

Games on the Market That Are Related to MAPPING

Note: Most of the following items can be purchased in local toy, department, or variety stores. Addresses for catalog suppliers are given at the end of this list.

	GAME	SUPPLIER	APPROX. PRICE
SHAPES	Lowenfeld Poleidoblocs, Set A	R.E.C.	$16.00
	Design Cubes	Childcraft	5.00
	Contour Puzzles	Creative Playthings	2.00
	Shape Matching Cubes	S.E.E.	3.00
	Construct-a-Cube Puzzle Set 1	S.E.E.	2.50
	Logical Blocks	Herder and Herder	19.50
	Mental Blocks	Childcraft	3.00
CONSTRUCTION GAMES	Play Plax Rings and Squares	toy stores Economy 5 & 10	8.50
	Lego	toy stores R.E.C. Economy 5 & 10	10.00-22.50
	Multi-Fit	toy stores Economy 5 & 10	10.00
	Construct-o-Straws	toy stores J. L. Hammett Company	2.00
	Moby-Lynx	Cuisenaire Company of America	4.00
REPRODUCING PATTERNS (STRATEGY GAMES)	MEM	toy stores Childcraft	7.50
	Switch	toy stores	1.00
	Puzzle Paths	toy stores	1.00
	Perception Games	S.E.E.	4.00
	Kadoodle	toy stores	5.00
	Stratego	toy stores	5.00
PATH GAMES	Beeline	S.E.E.	4.00
	Hexagon Game	Harrison & Jeavons & Co., Ltd.	2.50
	Connect	Creative Playthings	5.00
	Psyche-Paths	Cuisenaire Company of America	4.00
DRAWING AND REPRODUCING	Pantograph	J. L. Hammett Company	3.50
	Magic Etch-a-Sketch	toy stores Economy 5 & 10	4.00
	Spirograph	toy stores Cuisenaire Company of America Economy 5 & 10	4.00
3-D GAMES	Space Checkers	toy stores	4.00
	Tryptic	toy stores F.A.O. Schwartz	10.00
	Score Four	toy stores	5.00
	Fours	S.E.E.	4.00
	Qubic	toy stores Childcraft	3.00

Childcraft Education Corporation
P.O. Box 94
Bayonne, New Jersey 07002

Creative Playthings
Princeton, New Jersey 08540

Cuisenaire Company of America
12 Church Street
New Rochelle, New York 10805

Economy 5 & 10
1730 Massachusetts Avenue
Cambridge, Massachusetts 02138

J. L. Hammett Company
195 Pearl Street
Braintree, Massachusetts 02184

Harrison & Jeavons & Company, Limited
King Street
Whitestone, Leicester
England

Herder and Herder
232 Madison Avenue
New York, New York 10016

Responsive Environments Corporation (R.E.C.)
Learning Materials Division
200 Sylvan Avenue
Englewood Cliffs, New Jersey 07632

F.A.O. Schwartz
745 5th Avenue
New York, New York 10017

Selective Educational Equipment, Inc. (S.E.E.)
3 Bridge Street
Newton, Massachusetts 02195

finding a place

In this section, children have opportunities to explore the problems of finding a location and describing it to another person. As the children try to communicate their information, many will probably begin to see a need for some system of orientation and to realize that things look different depending on where you stand. At some point, most children discover that there are ways of using fixed landmarks as reference points for describing locations.

locating a landmark

Materials

paper
pencils
index cards

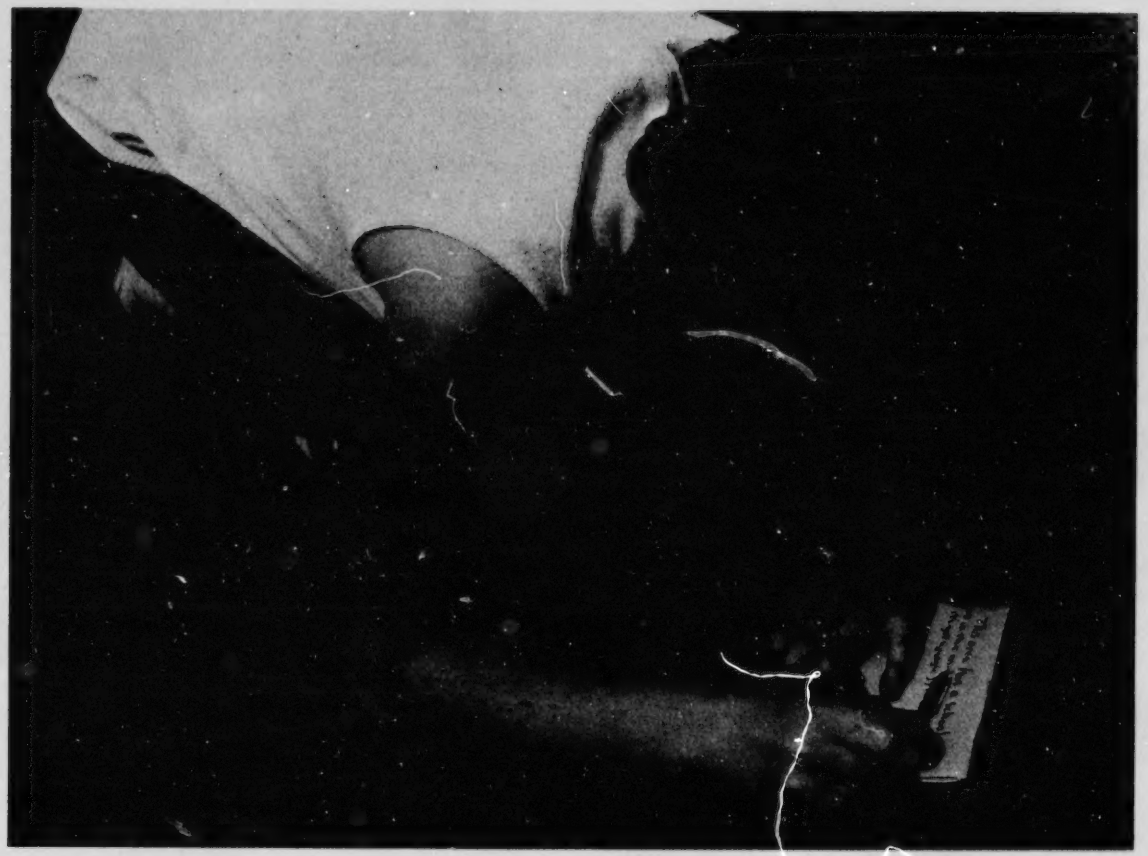
The children go outdoors in pairs and find a simple feature somewhere near the school, such as a hill, a stream, a valley, a field, or a small cliff. If the school is in the city, they can use nearby buildings or features of the schoolyard, such as a basketball court, an enclosed or steep area, a tree, or a fence. When they return, they try to describe the feature on an index card without naming it. They may use pictures, words, or both to help another team recognize and find their feature.

It may be necessary for you to locate ten or so appropriate landmarks in the vicinity beforehand to suggest to particular teams.

The activity could be organized in terms of a treasure hunt or as part of a project, such as planning for a fair in the schoolyard.

The children swap cards and try to locate each other's features. Many problems will come up:

"It took too long."
"We made a drawing, but it looks awful."



"We tried to give directions, but we didn't know which was north or south."

The children will be quick to identify problems they had with other people's directions:

"I couldn't tell which way to look at it."
"Her picture doesn't look much like a church."
"I couldn't tell which side of the fence they meant."
"They said, 'It's 50 feet away from the tree toward the brick wall of the new building.' Boy that was confusing! What part of the wall?"

After the children have looked at several people's pictures, they can discuss some general problems. It may be helpful to put some of the drawings and

directions on transparencies for use on an overhead projector.

What were some ideas that might have helped other people know what you meant?

"Directions for north and south."
"Write the names of things on the paper."
"Neat drawings."

Where were you standing when you drew your land features?

"We walked all around it."
"You need some other landmarks near it to tell which hill it is."
"You can't draw everything; you need symbols."

Practically every problem dealt with in this unit will come up in some form right away. Some children will indicate that they have extreme difficulty in recognizing or constructing configurations when they cannot reconstruct them in a familiar context.

"How can I tell what something looks like if I can't see all of it?"
"I just didn't know how to do it."

Many of the problems that the children raise have to do with distortion and changing points of view. They have difficulty drawing three-dimensional figures, and easily confuse side views with overhead views and combine the two.

Other problems involve describing the location of something by its orientation and its position in relation to other things. One thing is certain: most of the students will not solve these problems right away. As the unit progresses, they will have chances to confront the same questions again and again.

finding your desk

One way to start the class exploring questions about location in relation to other objects is to try an indoor game that involves orienting oneself in the classroom.

Materials

pencil
paper

Each child draws a map of the classroom and marks his desk with an X. (He does not put his name on his paper.) All the maps are put in a pile. Someone shuffles the maps and hands them out at random to the students. Everyone tries to read the map he gets and sits at the desk where he thinks X is. He then checks to find out whether the person whose desk he is sitting at is the map maker.

"This map doesn't make sense. You can't tell where the front of the room is."
"He says that this rectangle is supposed to be the blackboard, but it looks like the teacher's desk."
"He sort of got the whole room upside down and backwards. I sat exactly opposite where I was supposed to sit."

Looking at a few maps on the opaque or overhead projector may prove helpful.

When you look down on things, what do they look like? What do you see?
Do they look the same as when you look from the side?
What would this table look like if you looked at it from the ceiling?
What would a tree or the school building look like from the sky?
How can you tell how to hold this map?
Which side of the room is left? Which is right?
Does it matter which way you are facing?

If the class tries this activity again, they might rearrange the desks haphazardly to add a challenge.

"With everything a mess, you really have to use clues like the clock and the windows to figure out where you are."
"It could be this desk or this one. If he had put the bookshelf on his map, I could tell."
"I made my map with a key so I wouldn't have to draw everything."

looking at symbols

Materials

old and current maps

pencil and paper

Before making maps of their own, the children may find it helpful to examine different kinds of maps. A few examples of old or new maps hung around the room can provide questions for discussion about what the symbols on maps represent.

Does the blue always mean water?

Are mountains indicated in the same way on all maps?

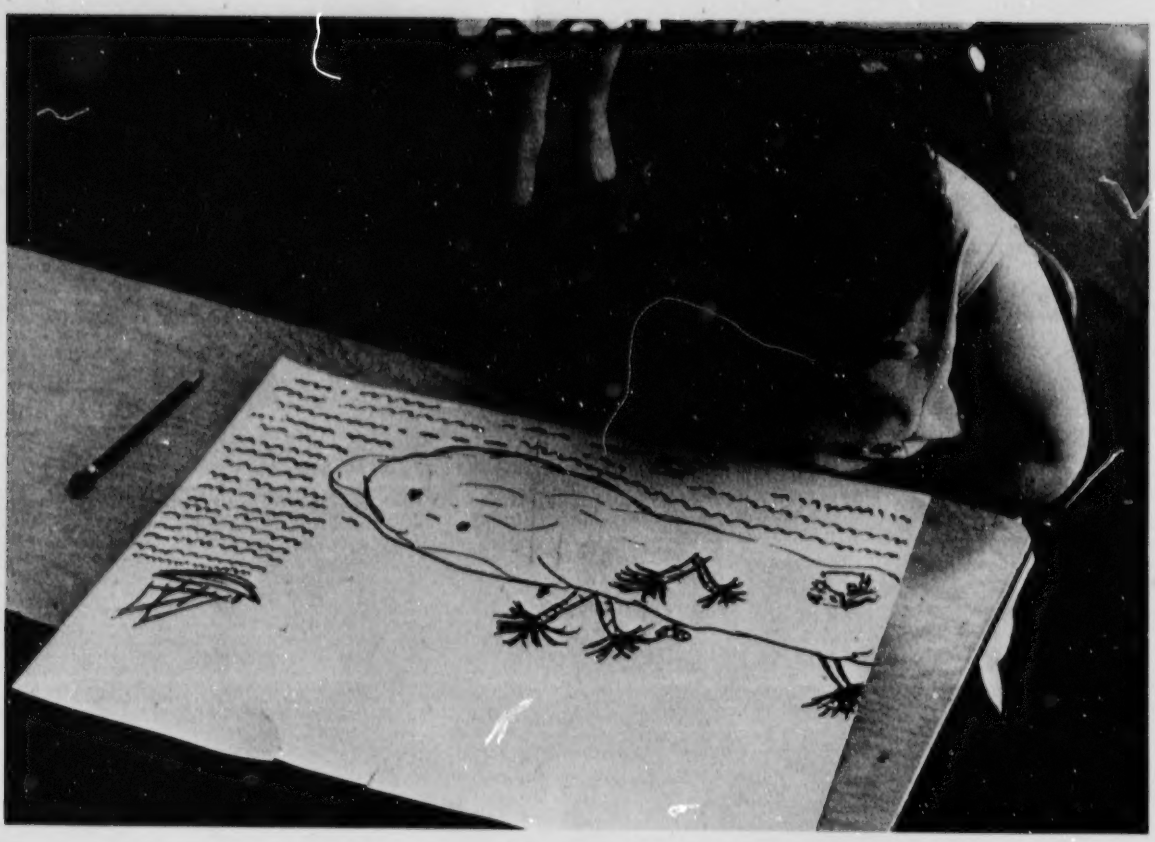
How do we know what the different sizes and symbols mean?

If I were standing on this spot on the map, would there really be a black dotted line under my feet?

"That's silly; you don't show boundaries on the land."

The children might make a list of those things on a map that they would see from a plane and another list of things that they would not see.

For many, the most complicated aspect of symbols is that while some symbols represent real things (such as lakes, rivers, towns, roads, and mountains) and tend to look like the natural or manmade features they represent, other symbols (such as latitude and longitude lines, the equator, and the compass points) represent ideas rather than real things. Some children may be able to discover this for themselves.



an imaginary island

Once children get the general idea of symbols and how they can be used, they may want to make up their own maps with symbols and keys. One activity that usually produces imaginative results is for each child to invent and map an imaginary island, including anything he likes on his map.

Materials

large drawing surfaces (brown wrapping paper, large drawing paper, or large pieces of cardboard)

crayons, colored pencils, colored ink markers

These questions may help children look hard at what they have done.

Can rivers travel up the mountains?

Is there a safe place for boats to land?
Where do you think people would be most likely to live on your island?
Is there any place for food to be grown or animals to live?
Is there anything your map doesn't tell us about the place?
Can other people guess what it is like to live there?

Mapping Games

Locating a Landmark

1 I See Something
2 Finding Shapes
3 Enclosing Shapes on a Geoboard
4 Measuring the "Outsides" of Geoboard Shapes
5 Shadow-Screen Shapes
6 Comparing Block Patterns
7 Matching Color Cubes Arrangements
8 Duplicating Tangram Patterns
9 Describing Play Plax Constructions

Finding Your Desk

10 Mapping the Room
11 Drawing Different Views of Blocks*
12 Holding an Object in the Same Direction as an Object You Can't See
13 Matching One Block with a Diagram*
14 Matching Several Blocks with a Diagram*
16 Drawing Different Views of the School

Looking at Symbols

17 Matching Objects with Symbols
18 Making Picture Sentences and Using Codes
19 Reading Symbols on Maps
20 Twenty Questions on a Map
21 Looking at Different Maps

See also page 21 and the following Elementary Science Study units:

Attribute Games and Problems
Geo Blocks
Light and Shadows
Mirror Cards
Pattern Blocks
Tangrams

*Some children will find these games far easier if they have had ample time to play and build with the blocks.

finding your way

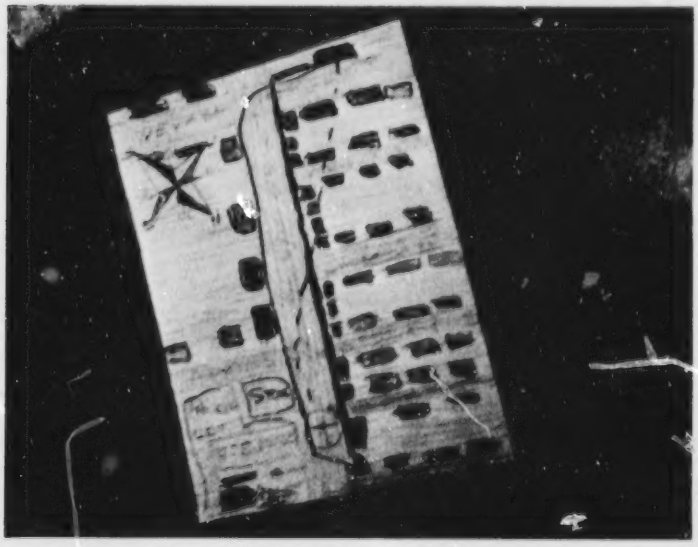
In this section, children explore many ways to give directions. The systems they develop for giving directions seem to follow a fairly predictable pattern. At first, children usually rely on clues in the room to use as landmark reference points. Secondly, they try small fractions of a turn to orient themselves. Only after much work, do they see any need for a common reference system, such as the points of a compass, for giving directions. (See also "Outdoor Activities," pages 17-18, under "General Ideas for Mapping.")

different routes

Materials

- index cards or paper
- pencils
- topographical maps and other maps of your local area (see page 20)

Each child draws a map or gives directions which will help a stranger (another child in the class) go from school to his house. Suggest that he show all the



shortcuts he usually takes — over people's lawns, through backyards, diagonally across the street, and so on. (See *Making Maps*, pages 15-19, for examples.)

What problems did you run into when you tested out each other's maps?

"It would have been easy if he had put the fence between his yard and the house next door as a landmark."

"I got the wrong street. He forgot that Hillside Avenue comes between this street and California Street."

"This map was perfect. I didn't miss one turn, and it really was the shortest way."

If you had to give your directions to a truck driver, would they be the same directions you would give to your partner?

What would a map for an airplane pilot look like? How would he even find our school in the first place? What are some major landmarks in the general area of our town that a pilot might find useful?

Some classes decided to do a large project of mapping their local community. They collected maps and charts from the chamber of commerce, the water company, the sewage plant, the telephone company, and the airport, and from these created their own maps and models of the community. Trips were made to check locations of land features important to pilots.

Children who are very familiar with the community might draw maps of the community without naming the landmarks or streets, so that others can try to fill in the names.

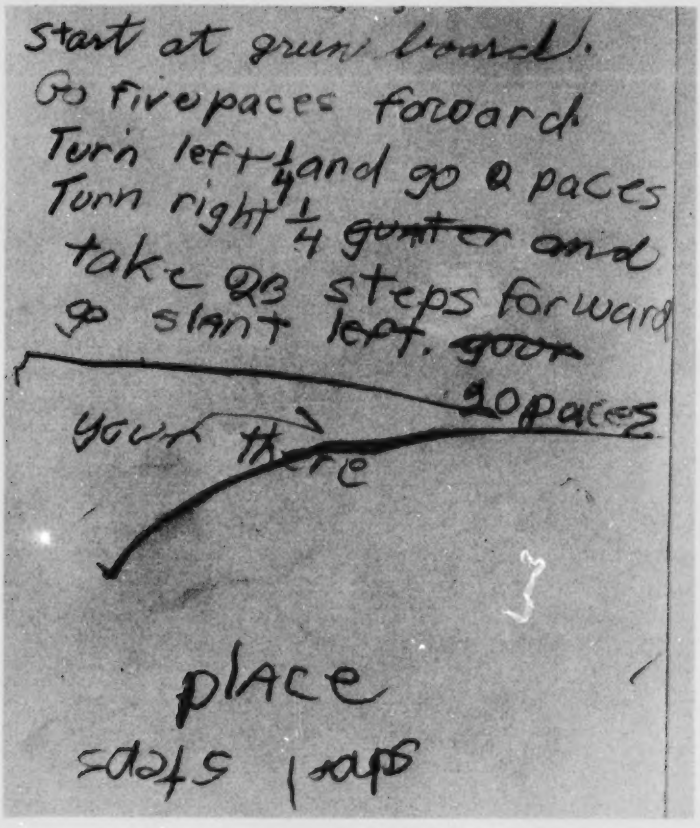
If you have extra maps of your locale, one person can make a puzzle of the map by cutting it into pieces. Others can put it together. (It helps to glue the map onto cardboard first.)

playing with paths

In the following activities, children try to follow directions and to direct others from point to point along a continuous path. There are many ways of exploring the possibilities of continuous paths. These activities begin almost spontaneously in classes where children are playing with model cars or where they have made mazes and want to guide small animals through them. Some classes even made large mazes for themselves.

Materials

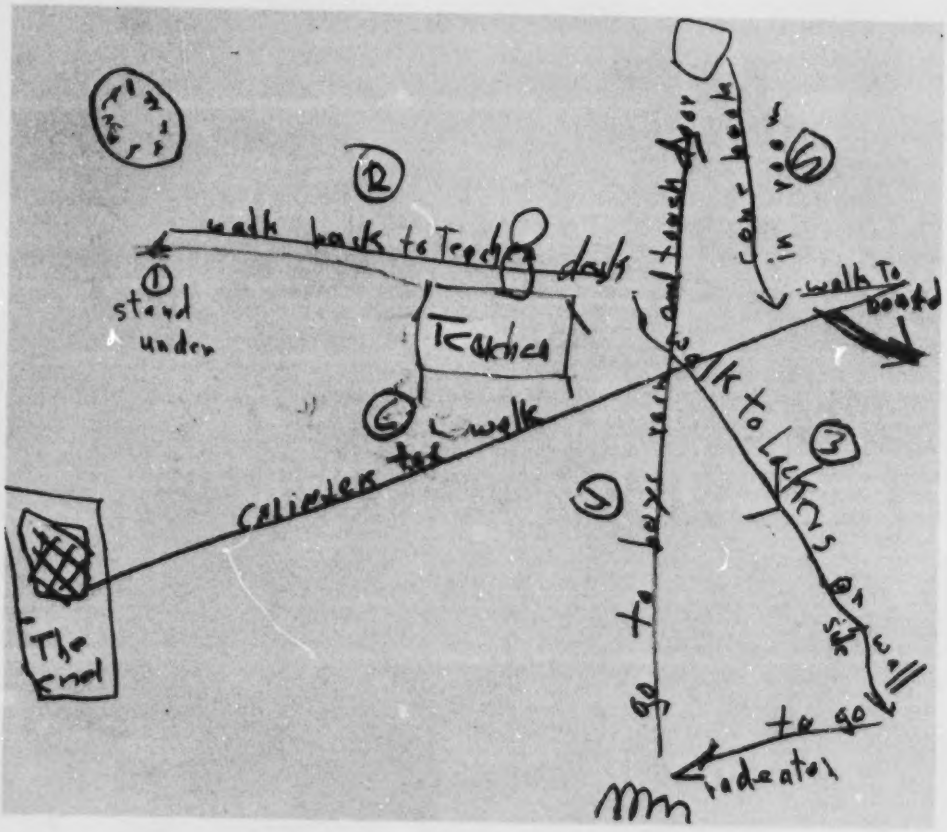
- index cards
- pencils
- measuring equipment, rulers, measuring sticks (when these become necessary)
- large geoboard (25-pin)
- colored yarn



Each child writes directions on an index card in such a way that his partner can follow a continuous path from point A to point B. It's probably easier to start out with paths inside the classroom

"He took too big steps."
"I couldn't tell which way to face."
"I wanted him to turn this way, but he went the wrong way."
"I landed on the desk."
"Go two steps. Turn left."
"How far?"
"Turn toward the wall. No, that wall. O.K. Now, turn toward the clock."

How can you get someone to turn without saying, "toward the clock . . . or wall?"



"Go left or right."

"Take three steps forward. Turn left. No go eight steps. Turn right. No, don't turn so far."

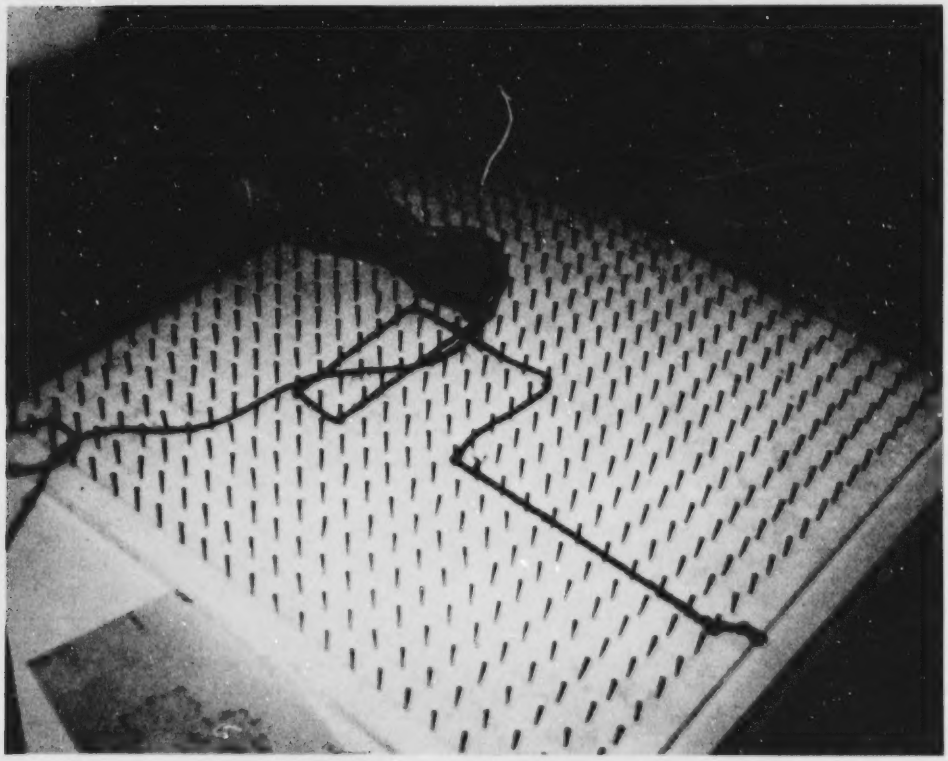
How can you tell someone how far to turn?

"You can say, go halfway or a quarter of the way!"

In some trial classes, children made mazes out of cardboard or of chairs and desks. One child directed another through the maze. A few even tried it blindfolded.

Some children find it helpful to practice making maps on the large geoboard with heavy colored yarn. One child gives directions and another follows the directions on the board, using yarn.

"Count six nails to the right from the bottom left corner of the geoboard. Start there. Go up (to-



ward the corner) seven paces. Let's call them steps. Turn right a quarter turn. Go ten steps."

Other children may want to walk the path on the floor. They can carry the geoboard along. Or they can take a ball of yarn and drop it behind as they walk.

"The path on the floor looks just like the one on the geoboard."

"No, it doesn't. It's too long here. He took too big steps, and here he took too little steps."

A few children will be able to make a path on a plain piece of paper, then mark it out on the geoboard or walk it out on the floor.

At some point, everyone may want to agree on how many feet a small pace and a large pace should be. The measuring wheel is useful for experimenting with standard measurements.

"You can go up the wall or on the furniture with the wheel."

"How much does the wheel measure?"

In general, it seems very helpful to move back and forth between geoboard paths, spoken or drawn directions, pictures of paths on plain paper, and paths on various sizes of graph paper. If you use graph paper with squares which are the same size as the geoboard squares, you can easily start work with scale problems. (See page 49.)

using directions outdoors

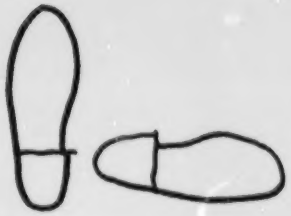
Following paths out-of-doors seems to bring out new problems.

Materials

index cards

pencils

Ask each child to pick a location out-of-doors and draw a map that will guide another student from one point to another. They can exchange their maps and try them out.



"It's harder to tell out here how far you should turn for a quarter-turn."

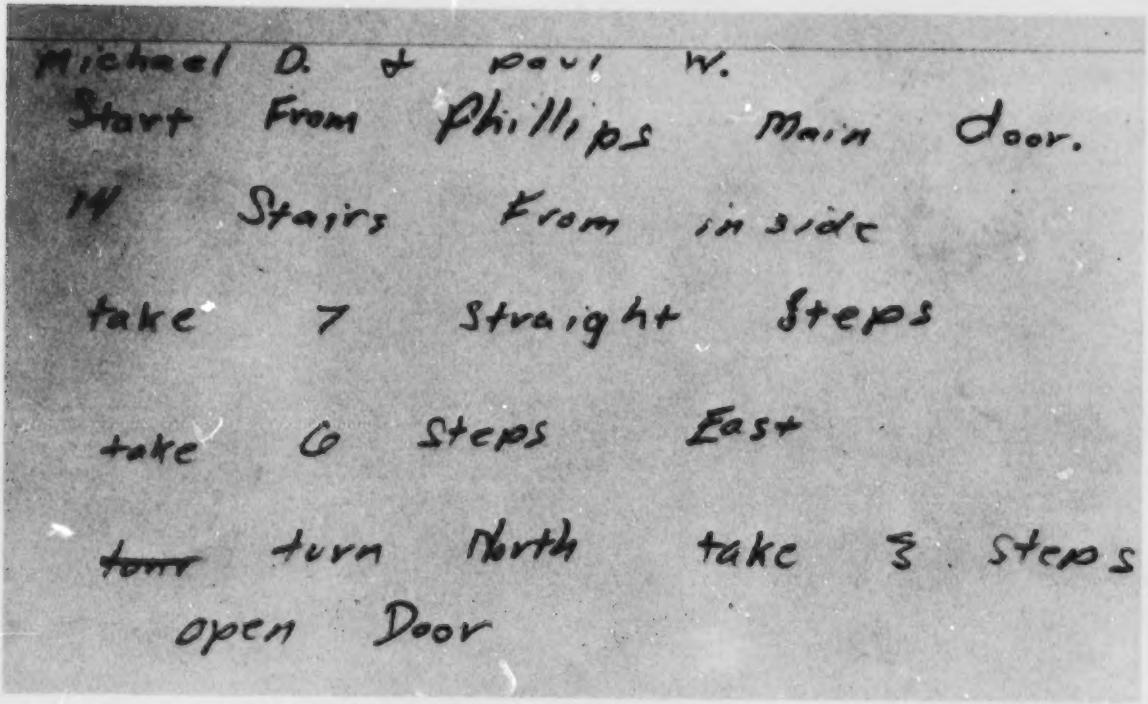
"I make my feet like this before I turn."

"I told my partner to 'Go to the tree, then make a quarter-turn.' "

What different systems of giving directions are you using? Which systems work best?

"Isn't saying 'Go toward the tree' cheating?"

"It's easiest if you start at something like the flagpole."

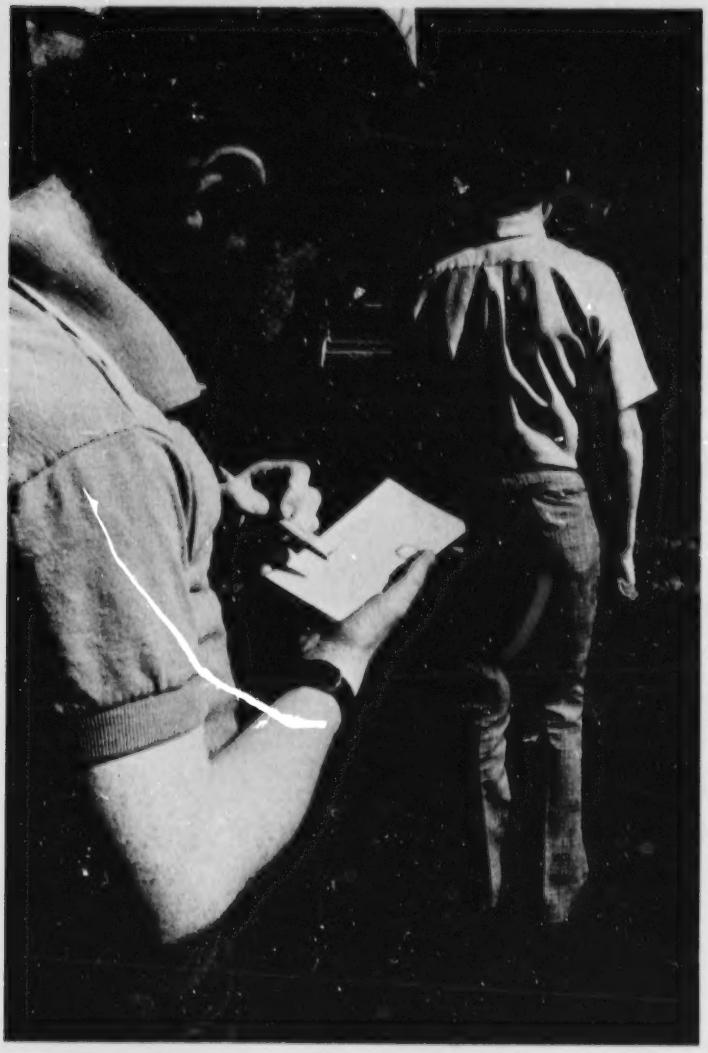

Michael D. & Paul W.
Start From Phillips Main door.
14 Stairs From inside
take 7 Straight Steps
take 6 Steps East
turn North take 3 Steps
open Door

Some children may see that indicating landmarks is often a shortcut to getting the partner to the right place.

If the children have not yet tried it, suggest that they give directions to get someone to a very specific point without using any landmarks as reference points.

"How can you tell him how to start out and which way to face?"

"He missed my spot by a couple of feet because he turned too far the last turn."



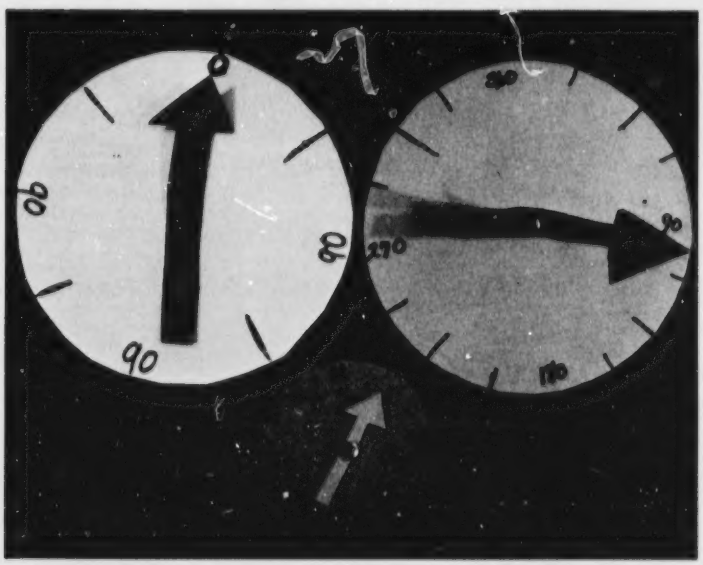
looking at compasses

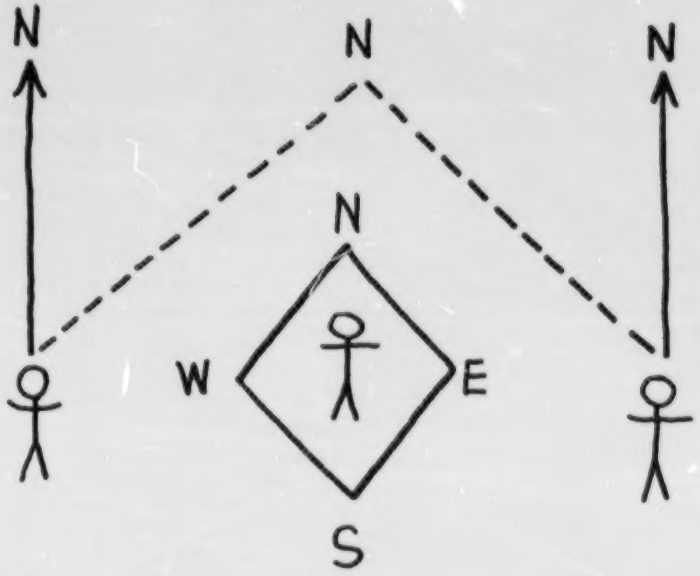
Suggest that the children make a device to help give directions. Children in trial classes made "compasses" of cardboard circles with two needles that can be moved around the center. One needle is used to indicate the way you face, the other shows how far you turn. (One child insisted that the needles should be arrows extending beyond the circle to show that the directions went on and on.)

It will become evident that many children have difficulty in understanding how a compass works. If they make something that indicates angles, they can, at least, examine some of the ways in which a directional compass can be used.

Materials

cardboard (some cut into circles)
crayons
rulers
construction paper
tape
glue
string
assorted commercial directional compasses





A common confusion is for children to walk along the dotted line rather than following the arrows when they are asked to walk north.

On one "compass," a child drew rays of different colors. This required others to use the same coloring system if they wanted to communicate with him.

> *"You have to have the same exact compass as your partner does or you don't know what he means when he tells you where to go."*

Most children need a good deal of help in finding north, south, east, and west. One problem is that most children think that N, E, S, W are specific points in space rather than directions. This problem is made more difficult when you have direction symbols on the wall or floor to indicate where N, E, S, and W are. The children tend to think of them as exact locations and walk toward those specific points rather than in the direction specified. They find it hard to understand that the center of the circle moves along with them.

To help the children locate general directions, have them go to different places in the room or yard. Ask them to use their arms.

> Point your left arm north and your right arm south.

If they are pointing toward a specific point rather than a general direction, you can say,

> Look at one another. Everyone should look the same. Everyone's arms should be in the same position.
>
> Move to a new place, and point one arm toward northeast. Do everyone's arms look the same?

At some point the children will be ready to examine an assortment of real compasses.

> *"There's only one needle."*
> *"What makes the needle move?"*
>
> What is the needle for? What does it tell you? Can you make it change direction?

"If you turn the compass, the needle doesn't turn."
"It points north."

Everyone stand facing the way the needle points. Look around you. Is everyone facing the same way?

"I don't know which end of the needle to face."
"There's an N on my compass, but the needle isn't facing it!"

Stand so that your left arm points toward the sunset and your right arm points toward the place where the sun rises.

Many do not know where these directions are and will need several mornings and evenings of observation to find out.

Now, you are facing north. Can you line up the N on your compass with the needle? Does it point north?

Children may enjoy having a chance to experiment with magnets and make some magnetic compasses.*

How are the commercial compasses different from the ones you made?

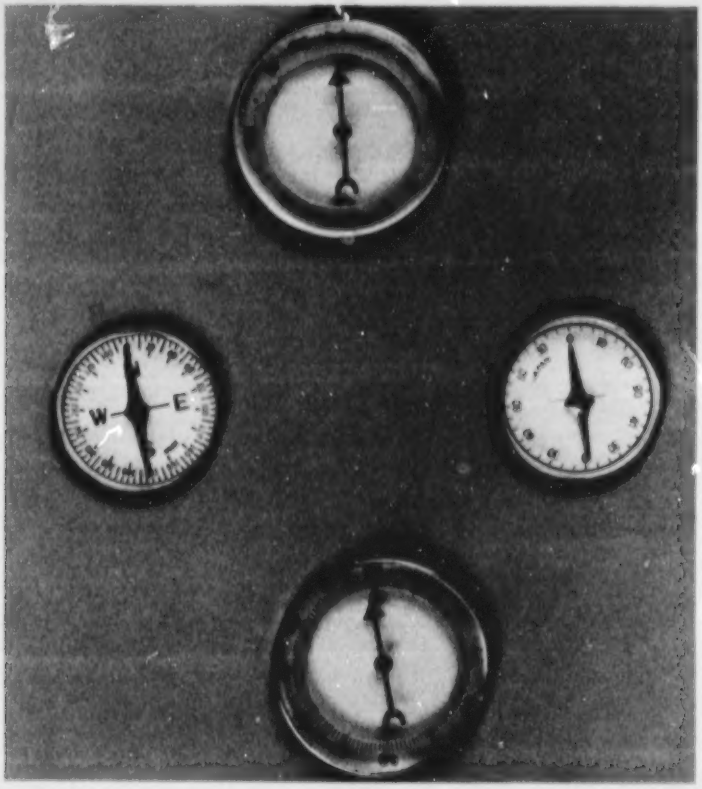
"There's only one needle."
"Mine doesn't have any numbers."

In what ways do the assorted compasses differ?

In the photograph, degrees of a circle seem to be used in several ways. On the bottom compass, the numbers indicate the fraction of a turn, such as a 90-degree angle. On the lefthand compass, each number indicates a specific point on a standard circle. 90° means the same as E, 270° means the same as W, and so on.

A few children may enjoy speculating about the advantages and disadvantages of different compass directions.

*See the Elementary Science Study unit BATTERIES AND BULBS, pages 75-83.



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Which directions do you think are easiest to understand?

7 o'clock
N by NE
N 17 degrees E
58 degrees

There is no reason to expect that children will understand how to use a compass right away. They will need much time to play and to try giving directions.

Mapping Games

Different Routes

22 Follow-the-Leader on a Map
23 Mapping Your Way from School to Home — Take an Unusual Route
24 Mapping Your Way Home — on Foot

Playing with Paths

25 Following Geoboard Paths
26 Finding Your Way Around the Room

Using Directions Outside

27 Finding Your Way Outdoors
28 Path Puzzles
29 Hide and Seek with a Compass

See also the Elementary Science Study units:
Daytime Astronomy
Match and Measure

looking at scale

By now, children have probably raised a number of questions about scale. When children transfer a model or a map from one arrangement to another — from the floor to a geoboard, from a geoboard to a piece of paper, from the outdoors to indoors — they often ask about scale. How can they keep things in the same proportions but make them bigger or smaller?

"He made the clock as big as the desk."
"Two cars can't pass on that road."
"You have to use 'finger steps' when you make steps on paper; real steps are too big."

mixing scales

When the groups join to coordinate their information, the need for a uniform scale usually becomes apparent.

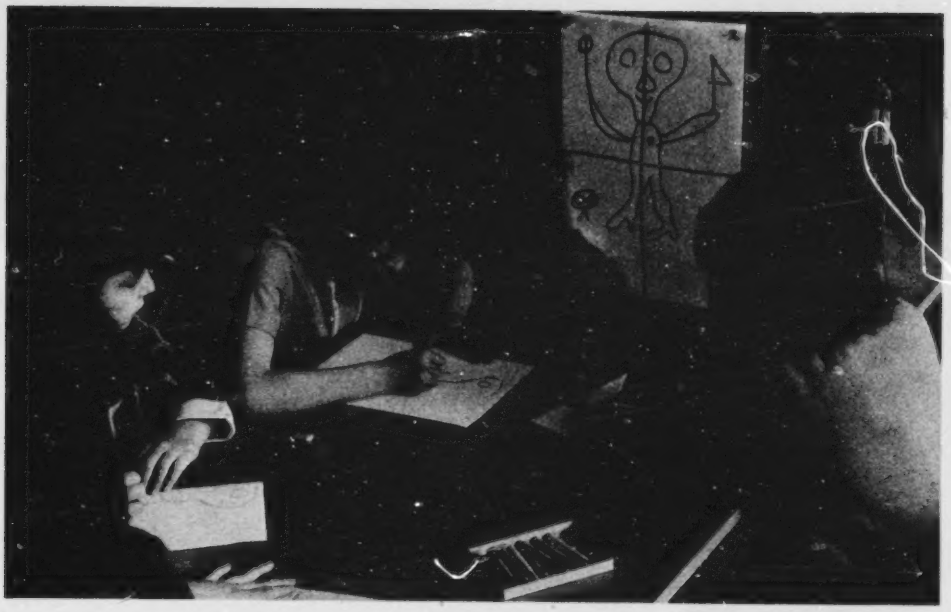
Materials

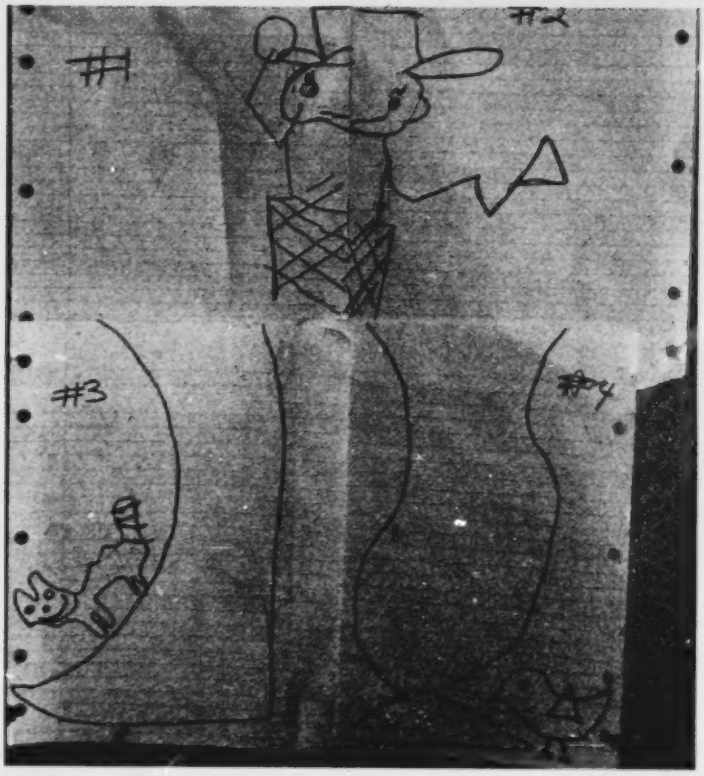
a huge picture divided by lines into four quarters
assorted sizes and textures of paper
assorted writing implements
cellophane tape

Hang a large picture where everyone can see it. Divide the class into four groups. Assign each group a number. Using crayon, pen, or pencil and any size piece of paper he chooses, each child draws the quarter of the picture with his number on it. When he completes his quarter, he matches it with three people who have done the other three quarters. The results are apt to be disconcerting and funny. (See *Making Maps*, pages 10-11.)

Is there any way you could do it so it would work?

"You could look at each other's paper."
"You could all do it on one piece."
"If you all had the same size paper it would help."





48

"Some people wrote dark and made thick lines. Other people used pencils, and you could hardly see."

If you tried it again, still without looking at other peoples' quarters, what guidelines could you decide on that might help?

"All use the same pencils."
"All use the same size paper."
"Tell everyone where you are starting."
"Draw the things the same size."

geoboards as grids

When children transfer a model from one place to another, they may find they can use a grid to help them locate the positions of the buildings.

Materials

geoboard (25-pin)
geoboard (10-pin)
Color Cubes (and other blocks the same size as the geoboard squares)
yarn
colored construction paper
colored rubber bands
Polaroid camera and film (optional)
3 assorted sizes of graph paper (preferably some with squares the same size as the geoboard squares)
pencils, crayons, colored pencils
tape

Using an assortment of materials — blocks for buildings, yarn for streets, and construction paper for areas such as parks, lakes, and parking lots — children can build a town on the large geoboard. The town can be extended by adding smaller geoboards to the large one. They can also build on cardboard or brown paper with a grid marked out on it or on a tile floor.

Invariably, difficulties arise which can lead to constructive extensions of this activity.

Everyone may want to try something different, the materials may run out, or another class may need to use the space.

The children may want to make a record of the construction so that the class can continue to work on it. One way would be to take photographs which can be used as a reference from which the town can be reconstructed. If graph paper is available, some children may start exploring how to translate their constructions into drawings onto it.

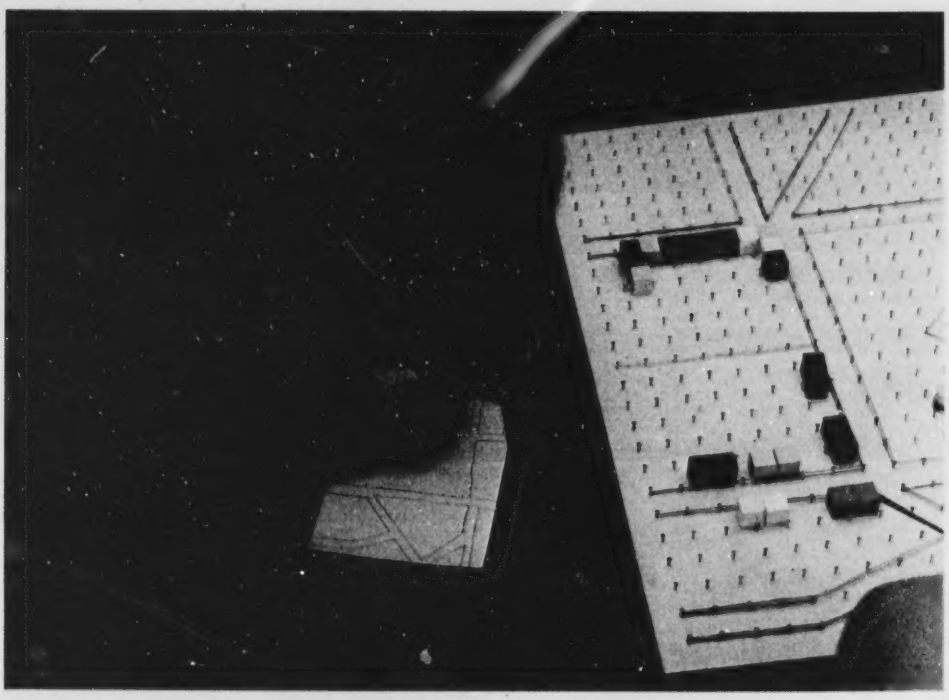
"You've copied your buildings backward; here's the front."

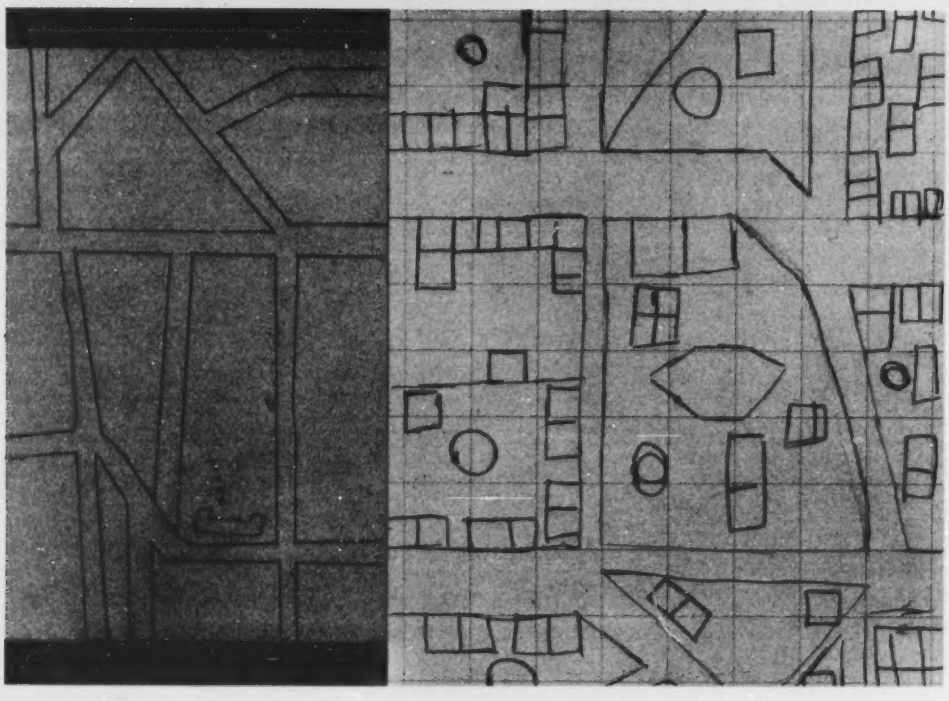
"That shouldn't go in that square. Here, count how many squares you are from the edge."

"My paper isn't big enough. Can I tape more to it?"

Many children will need to have graph paper with the same size squares and same area as the original geoboard construction in order to transpose their work from three dimensions to two.

As each individual transfers a different part of the town onto the graph paper map, some will see that it's a little easier if they have a reference system to tell where on the graph paper each building should be drawn.





"I can't remember where this goes."
"You could number the squares."
"We made up a good way to tell which square you should build on."

Since there are many good methods for identifying locations, let the children devise their own. They may have some ideas from the *Mapping Games.*

enlarging and reducing

Some children may discover that you can make an object seem bigger or smaller by projecting its image as a shadow. Photography can also change things to images of different sizes. Using a grid to change the scale of things is a special device that most children cannot discover for themselves.

Materials

opaque or overhead projector
collection of objects, maps, charts
light source or sunlight
Polaroid camera and film
sand
sandbox
drawing paper
rulers
pencils

The children can begin by experimenting with shadows (see Elementary Science Study unit LIGHT AND SHADOWS). If they project silhouettes of their own faces, how small or how large can the shadows be and still be recognized? If a map is projected on the wall, will its outline look like the original?

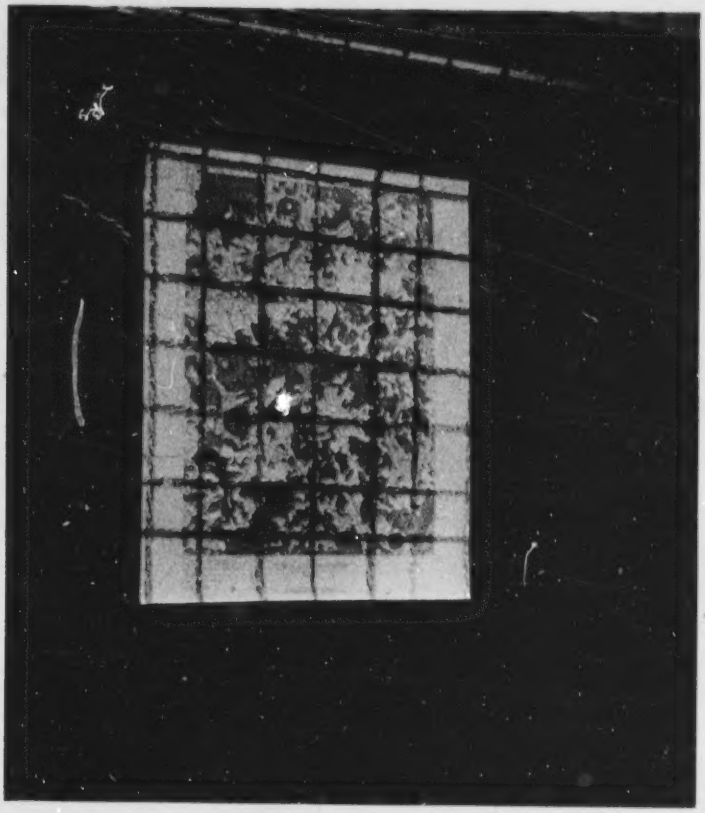
The children can experiment with photographs to see whether they reduce everything to scale. One class took Polaroid pictures of landscapes they had made in sand.

"Some things look too big."
"One hill's real fat and the other hill is too small."
"The sand goes up and down and the picture's flat, so it's never going to work."

Is it possible to take a photograph which would show all the parts?

"Well, if everything was in a straight line, it would work."

"If you take it from the top (overhead) it'll work, but it'll look funny."



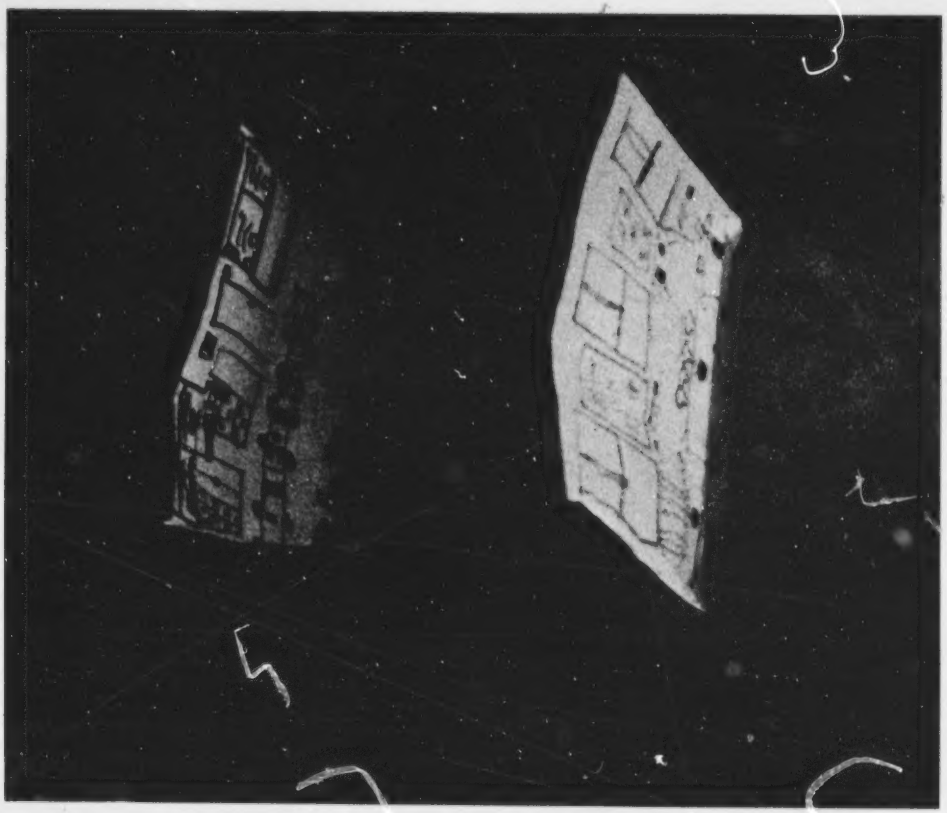
In one trial class, some children were fascinated to learn that they could use a grid to reduce the scale of a map. A group had completed an elaborate wall map. Quite a few people wanted to take it home. To help them copy it, the teacher projected a grid onto the map. Each child marked out a grid on a large piece of drawing paper. He then copied the wall map onto his paper, square for square.

"If you really look at how the lines go in each square you can copy it perfectly."

"Yeah, you can erase the grid lines later; then it looks as if you traced it."

three-dimensional grids

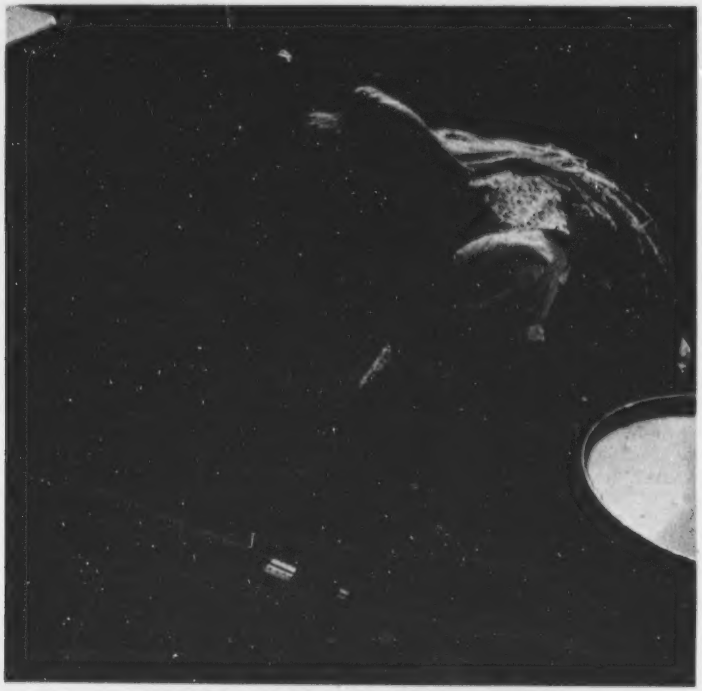
In the following activities, the grids the children use are very large. Rather than having an overview of the grid, they have to locate themselves inside the grid system.

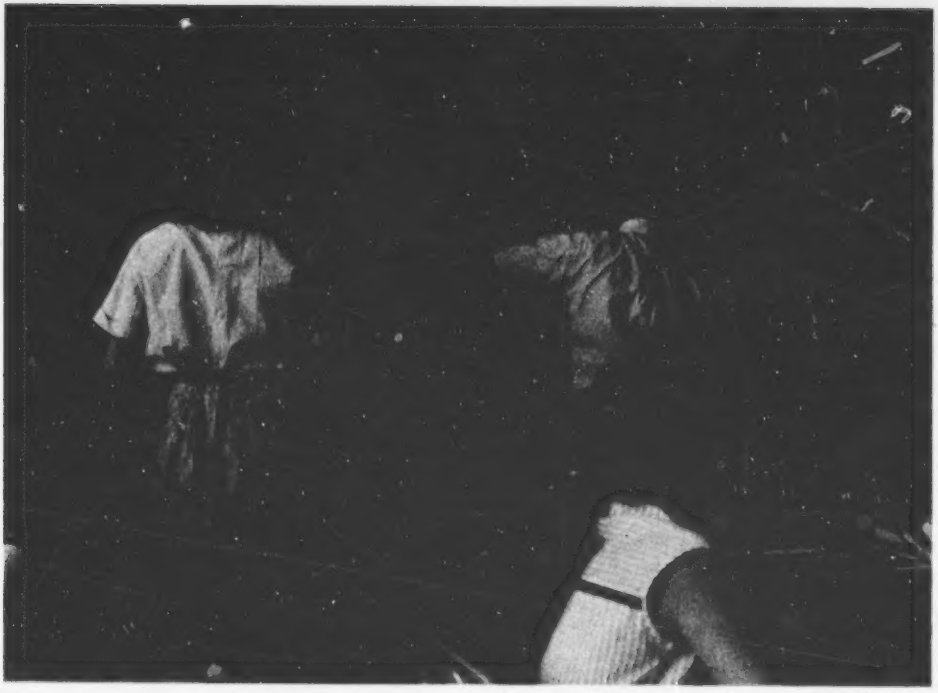


Materials

- paper
- pencils
- crayons
- measuring equipment (yardsticks, string, rulers, measuring wheels)
- colored construction paper
- thermometers

Small groups can make maps of the classroom. A number of children may want to work together to make one large map. Each can map a different piece of the room and put his map together with everyone else's. (For a detailed pictorial description of one class's experiences in mapping their room, see *Making Maps,* pages 20-24.)





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Some children will find it easier to build a three-dimensional model. Others will create a combination of two- and three-dimensional maps. Still others will draw diagrams, like blueprints. (See *Making Maps*, pages 12-14.)

How will you divide up the room?

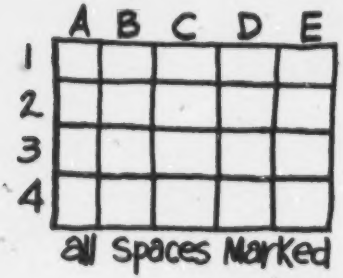
"We could each take a row of desks and go to the wall on either end."
"You have to have string and numbers and divide it up in squares."
"You have to measure the whole room first to see how many squares you need."

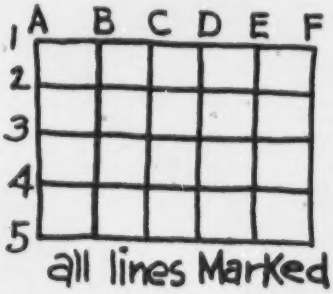
Can everyone stand in the section he is going to map?

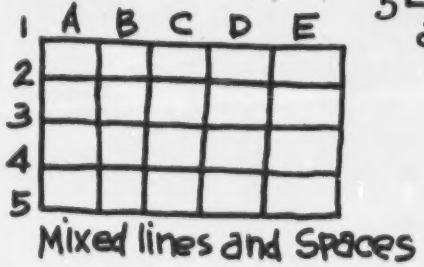
"I don't know where my section begins or ends."
"He says that's his section, but mine is section 2E."

If any children are having trouble with using grids, try some examples of grids on the board or on a worksheet.

Ask the students to describe specific points on the different grids to another person. Can they describe areas enclosing more than one square? (This can also be done outside or on a sand model.)







Another project might be to make a map or a three-dimensional model of one floor of the school. Small groups can do different rooms. They will have to coordinate their efforts when they put the rooms together.

"The outside wall of the school is straight; it doesn't go in there."

"The rooms are not all the same size."

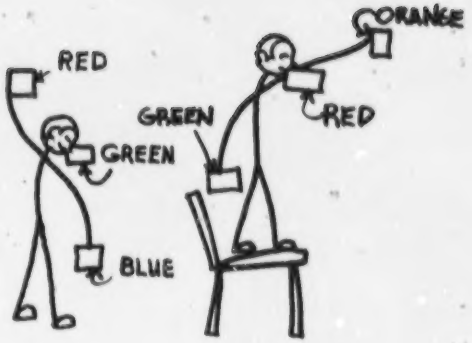
"We forgot to leave room for the hall."

One trial class created a three-dimensional map of the temperature of their classroom.

Temperature	*Colors*
78°	(yellow)
76°	(orange)
74°	(red)
72°	(green)
70°	(blue)

These are their directions:

- Take the temperature of the room at different heights and positions.
- Find what the average temperature is and assign a color to it.
- Pick two temperatures on either side of the average and assign a color to each.
- Divide the room into a grid.
- Each person stands in a certain position to form the grid.
- He takes the temperature of the room at three heights.
- When everyone has done this, he takes the scraps of colored construction paper which are assigned to each temperature he recorded.
- He holds his pieces of paper in the places where the temperature matches the color. This makes an immediate visual, three-dimensional map, without anything being put on paper.



Mapping Games

Mixing Scales

11 Drawing Different Views of Blocks
13 Matching One Block with a Diagram
14 Matching Several Blocks with a Diagram
15 Matching Block Buildings with Photographs
30 Copying Pictures Using Graph Paper

Geoboards as Grids

31 Tic-tac-toe
32 2-D checkers
33 Battleship

Enlarging and Reducing

34 Using Graph Paper to Enlarge and Reduce Pictures
35 Making Blocks Look Bigger or Smaller
36 Enlarging and Reducing Shadows

Three-dimensional Grids

37 3-D Tic-tac-toe
38 Finding an Object in 3-D

outdoor mapping

The outdoors lends itself to many different kinds of mapping projects. The children can map their schoolyard or their neighborhood. They can map the way the area looked before there were any buildings. They can choose an area — perhaps a blighted area or an empty lot or field — and plan changes for it. They can map sequential changes in a fixed location, seasonal changes in and around a stream, the sky at different times of the year, demolition and redevelopment of a city block, landfill operations, new buildings and roads.

landmarks and compasses

Materials

- pencils
- paper
- measuring equipment (yardsticks, measuring wheels, string)
- directional compasses
- transparent acetate
- sighting rulers

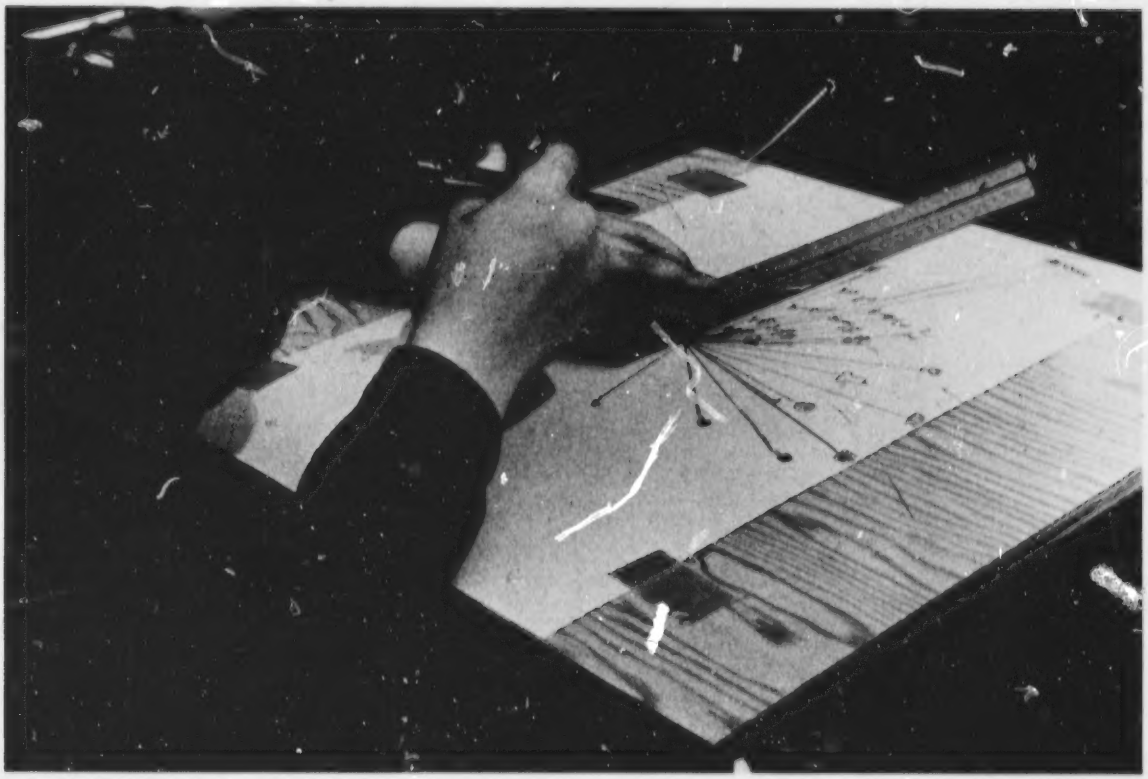
One way children can start mapping outdoors is by making maps of the schoolyard. Give every pair of students a large piece of paper. (This could be cut into a large circle.) Then, suggest they stand somewhere in the schoolyard so that they are in the middle of their map and record features they see about them.

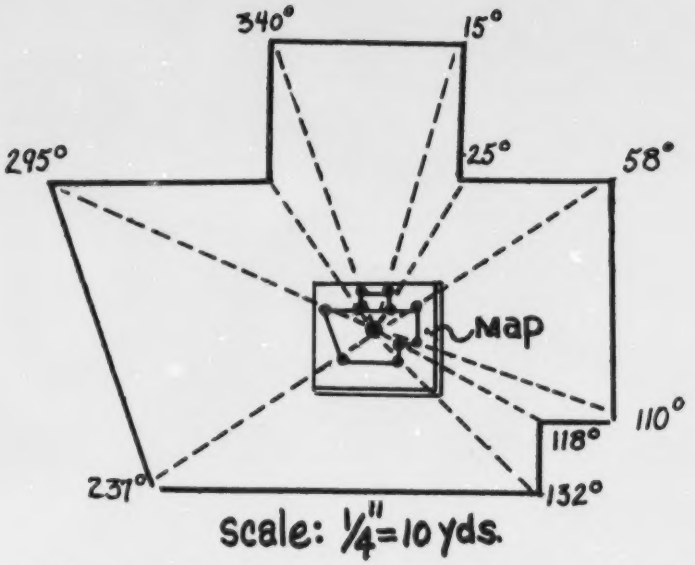
- How far away are the landmarks you want to record?
- Can you use the compass to tell where on your map to place the flagpole? The corner of the school building? The fire hydrant?
- If you measure how far away things are, how do you tell where to put them on the map?
- Does it make a difference if you move to another place in the yard while you are making your map?

After the children have made their maps, give them time to look at one another's maps and discuss them.

Do all these maps look like maps of the same place?
Can you tell where the map makers were standing?
What are the things that make each map different from the rest?

"The church looks as if it's in the schoolyard."
"You can't fit the church on unless everything else is tiny."
"I think you should use symbols for the buildings, since you can't make them the right size."
"It doesn't really matter what you put at the top of your map because you can just keep turning it around."





Another activity that will give children practice in drawing distances to scale is to make maps that show the shape of the schoolyard and its boundaries. Here is one way to do it:

- One child measures how far away each corner of the property is from where the map maker stands.
- The map maker stands in one place and sights along a ruler to the same corner that is being measured, or he can use compass directions as a guide.
- He converts the measured distance to the scale he has chosen for his paper and draws a light line (one he can erase) to represent the distance to the corner.
- After he has mapped all the corners, he joins them with straight lines. The connected lines show the shape of the property.

mapping a hilly area

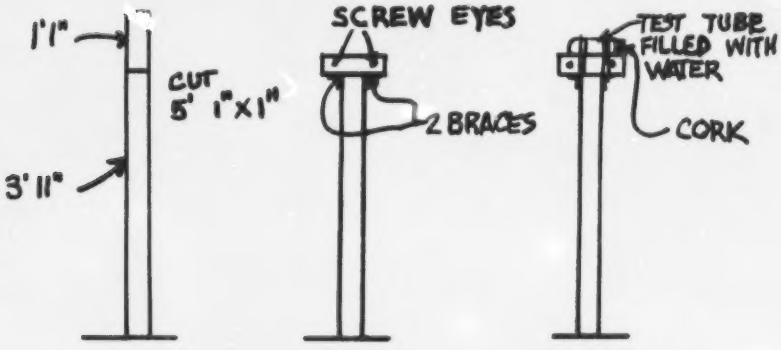
If the children are mapping a hilly terrain, they'll want to know how to convey different elevations. Let them use any methods that they think will work for them. Many children will have to try various techniques before they see what kinds of problems are involved in mapping elevations. Others will be able to plan ahead.

Materials

Note: These should be made available only *after* the children have explored their own methods for finding and measuring elevation.

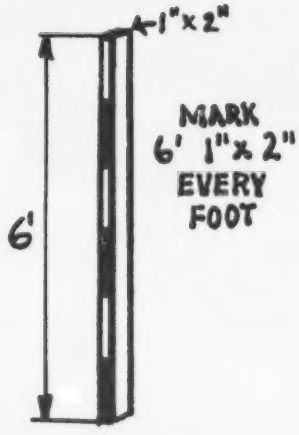
For levels

3 5-foot lengths of 1" x 1" soft wood
6 screw eyes
3 6" x ⅞" diameter tubes, closed one end, and 3 corks to fit
6 rubber bands
6 large braces with screws
screwdriver



For markers

unbent coat hangers
colored construction paper
tape



For range rods

2 6-foot lengths of 1" x 2" soft wood
heavy crayon or paint

Let the children try all their ideas for mapping a hilly area. For some, moving back and forth between making a three-dimensional sand model and drawing a two-dimensional map will help sort out some of the difficulties (see pages 70-72).

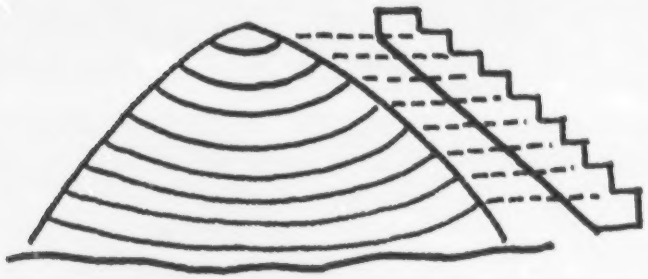
How do you show on your map that the land goes up and down?

"You can show it sideways."
"You can build it up with papier-mâché."
"You can build a model in sand first and then make a map."
"You shade the areas that go down and up."
"You make different levels different colors."
"You can write where the high and low places are."

When the land goes up, how do you draw it so it doesn't look as if you mean it's far away? It's high; it goes up, not just out in distance.

"If you were in an airplane you could do it."

If you changed the hill into something flat, how could you fit it all on the map?
How does a hill compare to a flight of stairs? How would you draw the stairs on a map?
How can you figure out how high or low different places are?

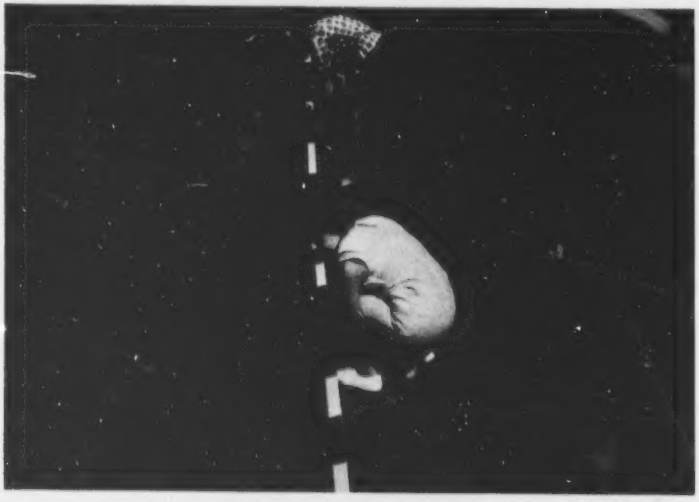


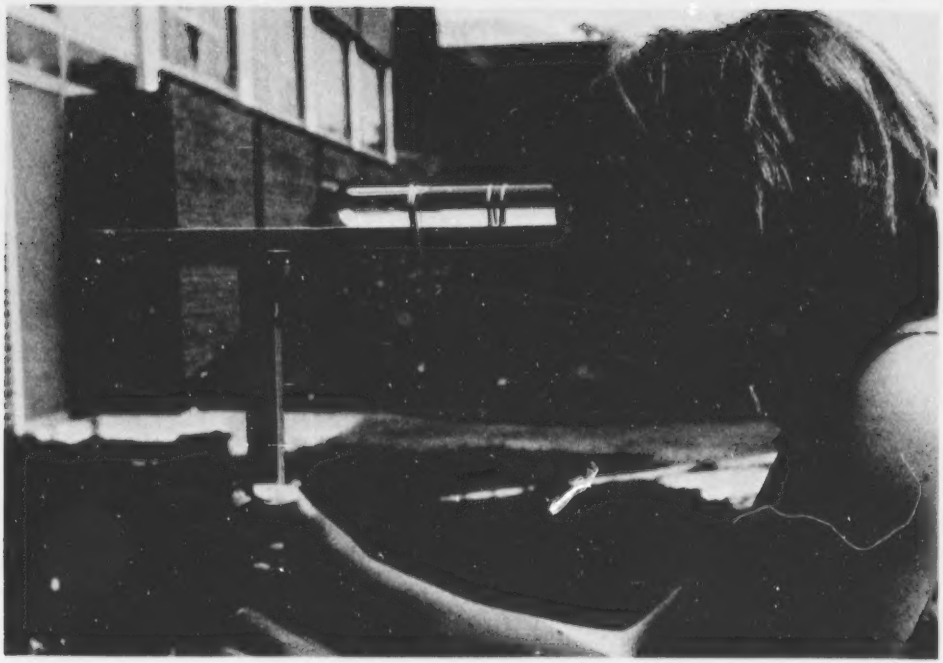
"If it's steep, it's high. If it's not so steep, it's not so high."

"That's not always true; look at the wall. That's steep but it's not so high as the hill."

"You can take those long sticks and use them."

Having the levels and range rods available will give the children new ideas. Some will try laying the range rods on the ground. Others will see that you have to stand them up. Some will see that their eye must be at the level of the height they are measuring.



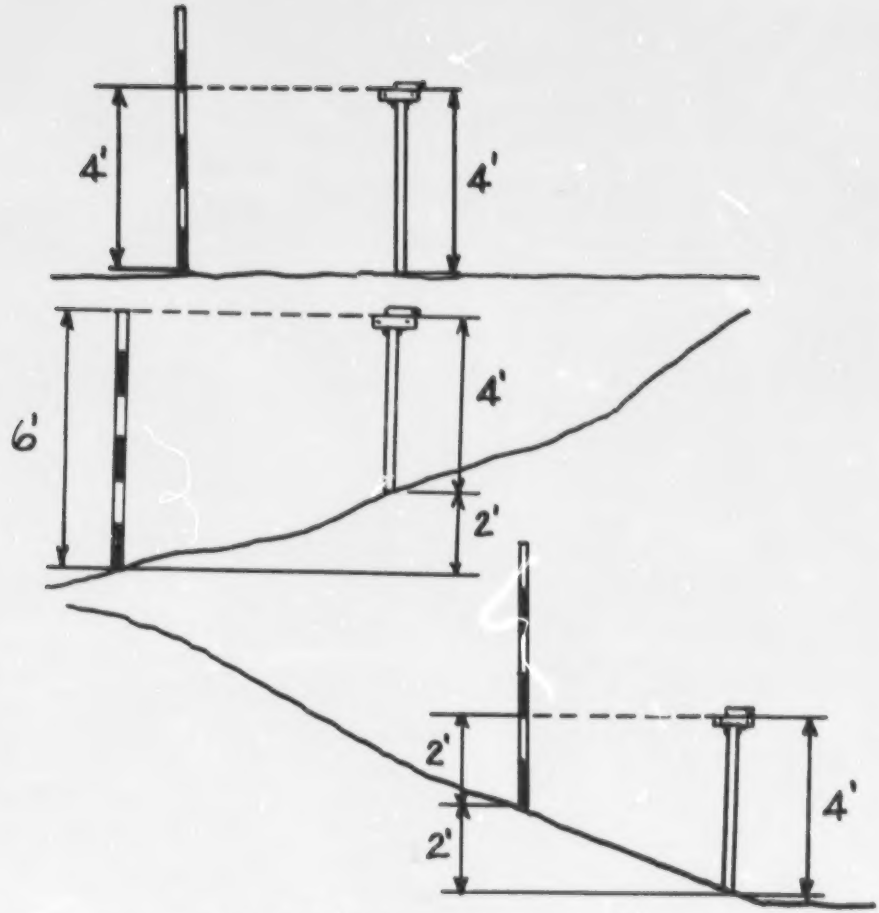


These questions may help the children focus on the problems of using a level.

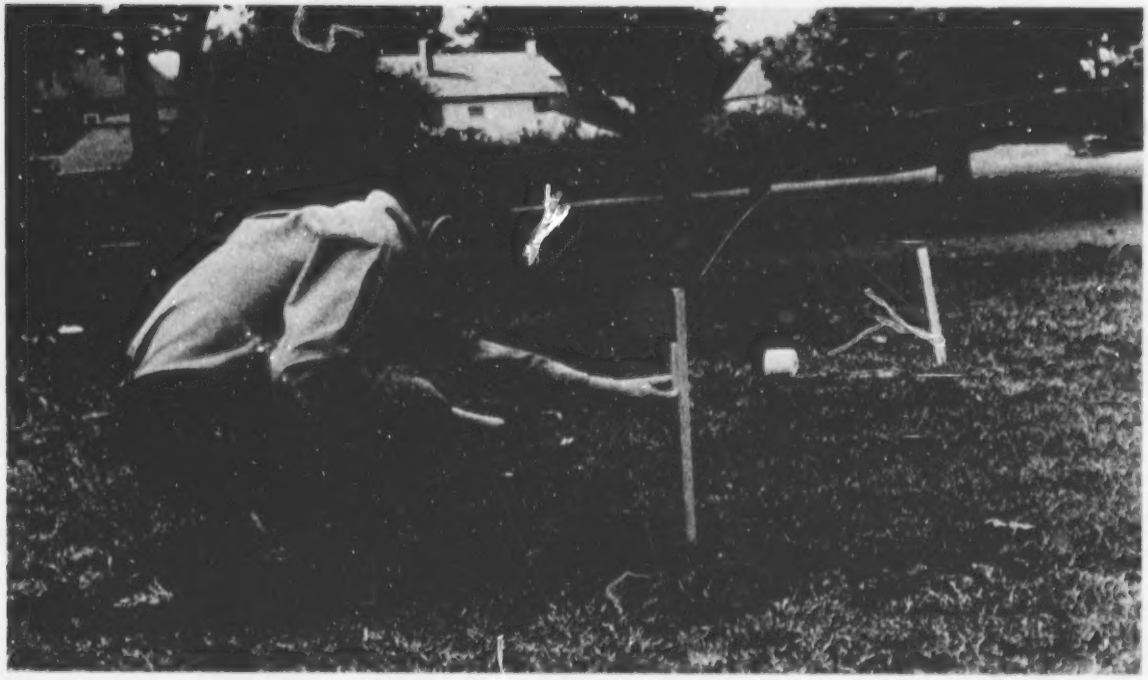
How can you tell you are really looking straight, not up or down?
What happens to the bubble when you tip the level?
How can you tell when the level is horizontal?
How high is the level from the ground?
How can you find all the places in the area that are at the same height?

Here is a list of directions one class made for using the level and the range rod.

- Find the elevation of most of the area (usually it's a low area).
- Make this height your common reference point. Measure everything else from it.
- One person looks through two screw eyes along the level from the common reference height. Others go off with the range rod.



- Wherever the person who looks through the level can see the 4-foot mark on the range rod, the land is at the same height as it is where he stands. (The level itself is 4 feet high.)
- Wherever the person with the level sees the 3-foot mark on the range rod, the land is 1 foot higher than where he is standing.
- If the person with the level moves, you have to know how much higher or lower his new location is in comparison with the common reference point.
- Stick a colored marker in the ground at all the places at the same height as the common reference point . . . that are 1 foot *above* the common reference point . . . 2 feet . . . 3 feet . . . and so on. Use a different color for each new height.



- Stick a colored marker in the ground at each foot *below* the common reference point. Use a different color at each new height.
- Look at the colored markers. The different colors will give you an elevation map of the area.

To make markers, you need:

a piece of wire (unbent coat hanger)

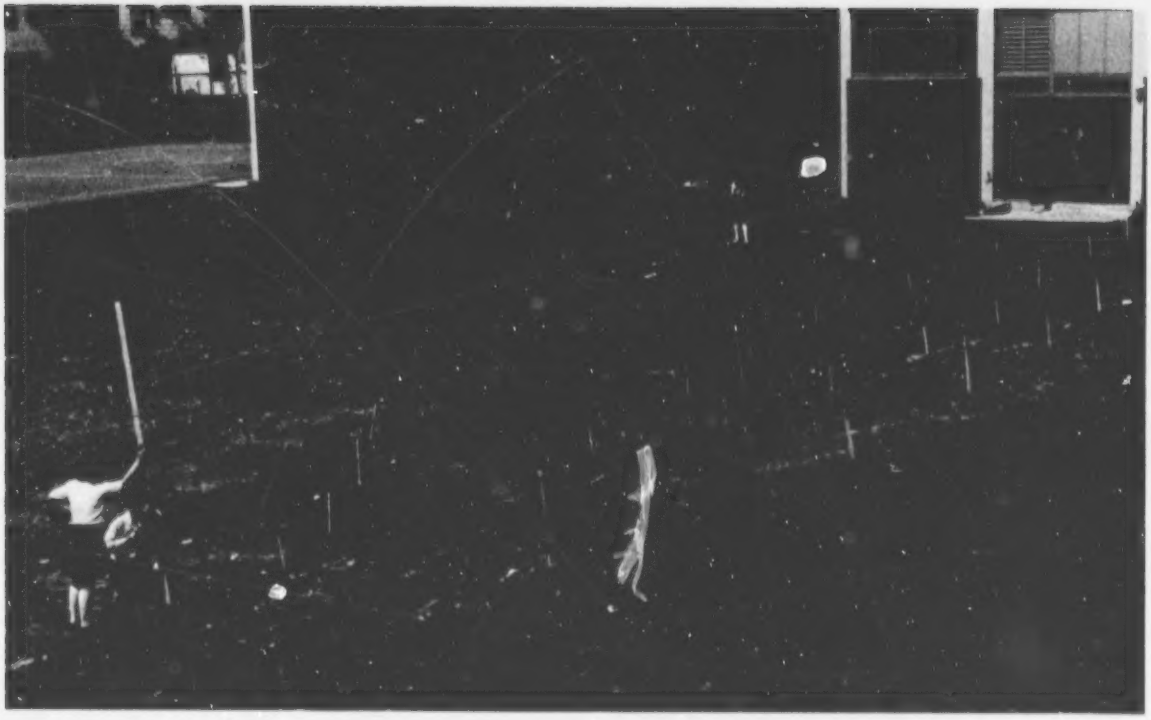
a piece of colored construction paper taped on the wire (one color for each elevation) red = 1 foot above, green = 2 feet above, blue = 3 feet above, yellow = 4 feet above, orange = 1 foot below, purple = 2 feet below

A few children may want to map the locations of the colored markers.

Can you draw a line joining all the markers of the same color?

Do the colors come out in any patterns?

If you were flying over, would the colors make a pattern?



Mapping the markers is not easy, since the map makers must take distance and elevation into consideration simultaneously. Also, in order to show the locations of the markers to scale on their maps, they must convert the slope into horizontal measurement. (See the first photograph on page 65.) If they get the general ideas of some of the difficulty of plotting different elevations on a map, they are doing well.

making maps from 3-d models

Children should have access to sand for making maps and models throughout MAPPING. While some work on making maps on paper, others can build maps in sand. The following activities can be tried anytime during MAPPING.

Materials

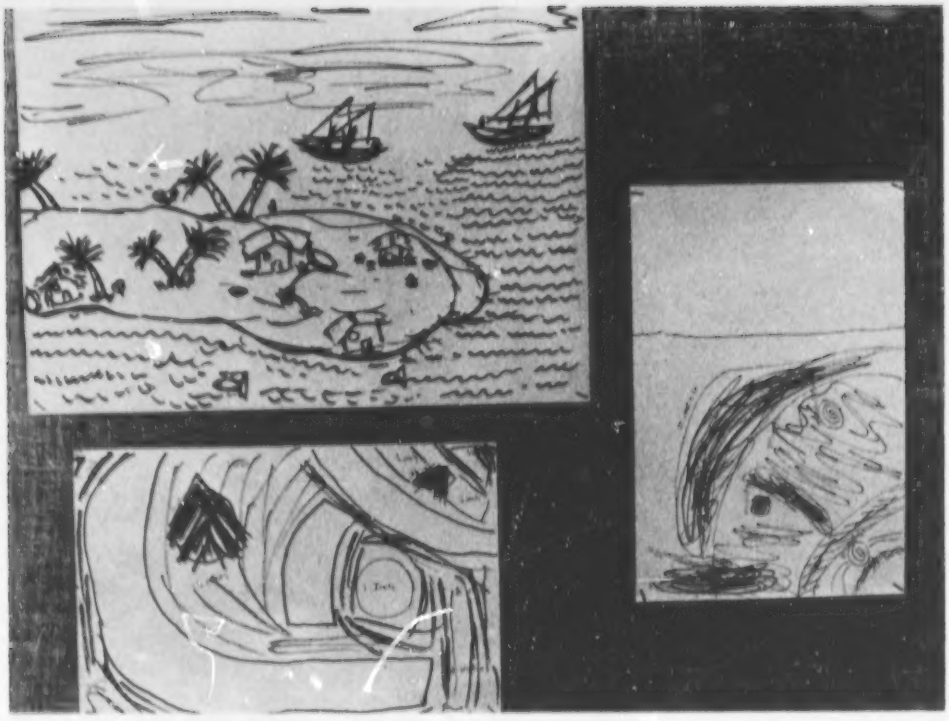
sand
water
containers for water
paper
pencils

In pairs or small groups, the children can make simple sand models of landscapes. They may need to sprinkle the sand with water until it is wet enough to stick together.

The following are a few of the kinds of questions you can ask as you look at their work:

Where do streams usually get wider?
Can we tell which bank is which?
Is there a landmark you could add to the model which would help tell where we are?
How far away is that cliff and which direction does it face?
If the tree is that big, how high do you think the hill should be?

"Let's use plants to make trees and pretend that little rocks are big ones."

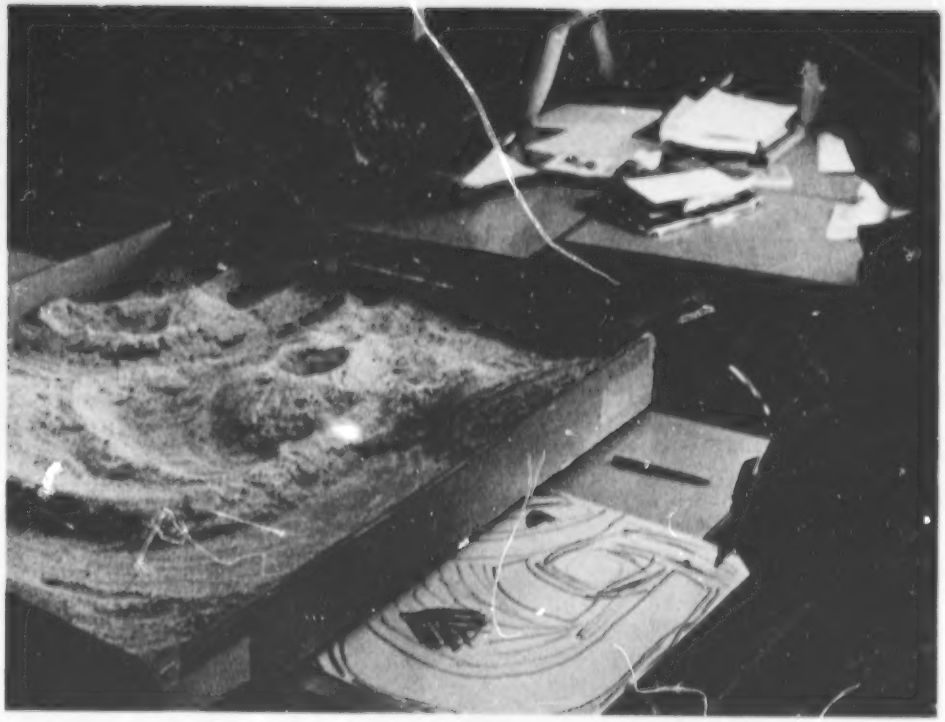


Suggest that the children make "mystery" maps of their models. Hang the maps or have children swap maps. Can others find the model from which the map was drawn? Do all the maps of the same model look alike? If not, how and why are the maps different?

Why is it easier to draw a map from the model on the sand table than it is outside?

"You can see the whole thing all at once."
"It's easier to draw things the right size."
"We can look down from the top."

Some children may want to explore how a grid system can be used to help find locations. They can try to build some of these on their models. Each group can give directions for getting to a specific spot and see if the others can get there. Can one group give directions to another group if the second group is using a different locating method?



showing elevations on models

Materials

modeling clay
plastic shoe boxes
plastic or cardboard boxes (sand boxes)
probe sticks
plastic liners for sandboxes
grease pencils
cotton string
rulers
scissors

The children can try making models that show different elevations.

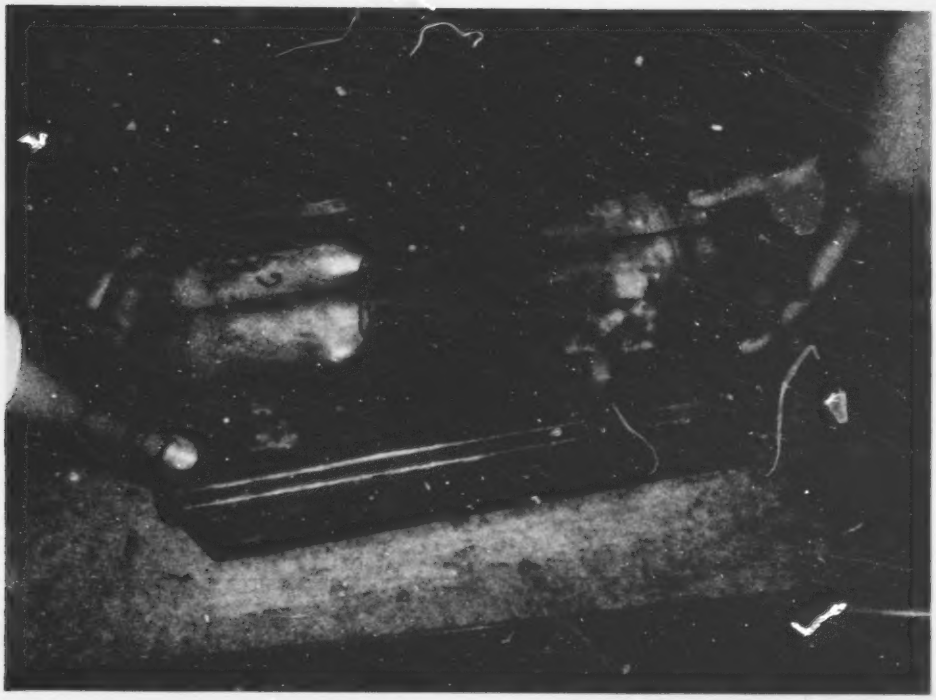
How can you show how high the hill is in your sand model?
Does your model show where the hill is steep or where the slope is gradual?
Are the valleys all the same depth?

It may be easier for the children to show elevation if they construct simple land features, such as a single hill, or two hills and a valley.

At some point, you may want to show the children how to make contour lines to indicate elevation. The following directions are for making contour lines in modeling clay:

- Build a hill about 5 inches in diameter out of modeling clay.
- Put it in a clear plastic shoe box.
- Place a strip of masking tape up and down the outside of the box.
- Mark the tape every ½ inch from the bottom to the top of the box.
- Pour water into the box until the level of the water reaches the first mark on the masking tape. (Dye the water with food coloring if you need to see it better.)

- Use a sharp object (pencil point) to make a groove around the modeling clay where the water's edge hits it.
- Add more water until it reaches the second line on the tape.
- Mark a second line where the water hits the model.
- Continue till the water covers the model.
- Pour out the water, leaving the model in the box.
- Place the lid on the box, and put a sheet of clear acetate film on top of the lid.
- Look at the model from a single point overhead, or keep one eye closed and the other eye right over the pencil.
- Trace the grooved contour lines into the acetate with a grease pencil.



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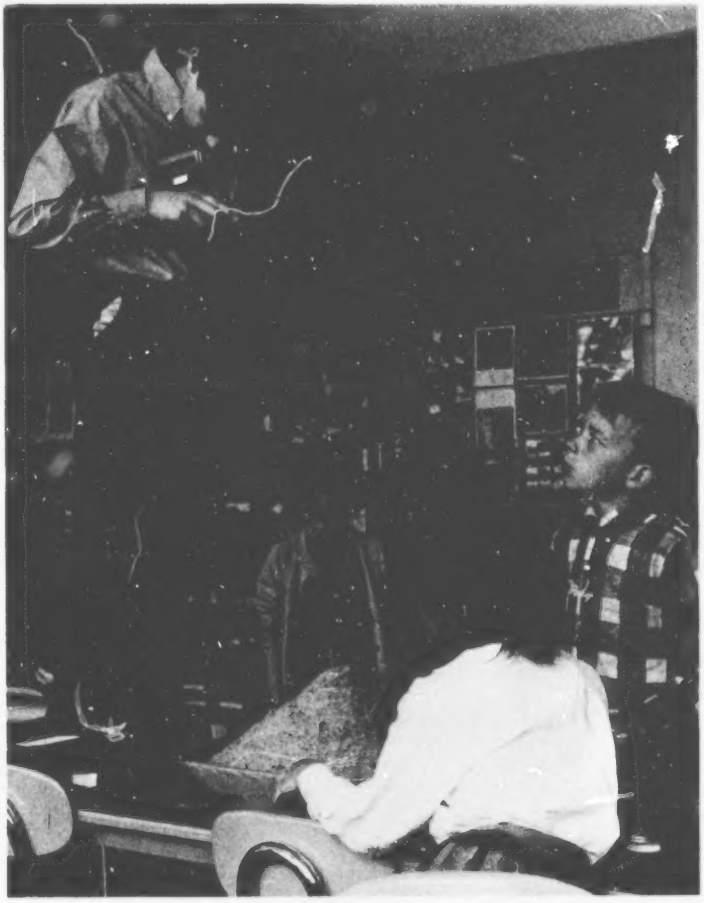
How do you tell where the low places are?
Are the smaller rings at the top or bottom of the hill?
How can you tell where the hill is steep? . . . where the slope is gentle?

Groups of children can work together to make contour lines on sand models. Using probes marked in inches and cotton string for contour lines, the children can show the different levels on the models.

If you were to walk around the mountain on each piece of string, would you be going up and down or staying level?
How did you figure out where the 1-inch . . . 2-inch . . . 3-inch line should be?
Do the strings always have the same amount of space between them?
When are they close together? When are they far apart?
Do any of the strings touch?



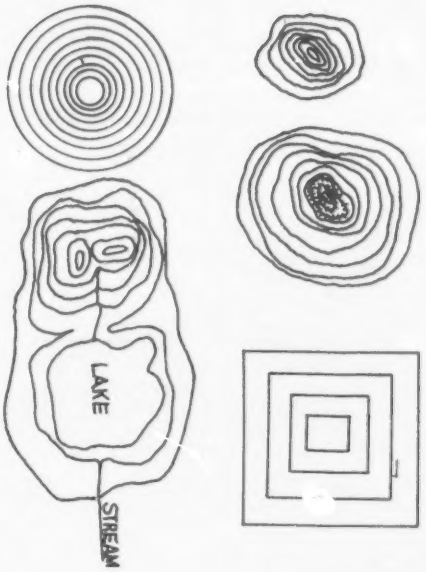
Don't be surprised to see children winding the string up or down the mountain in a spiral. Many will measure the space between the strings along the angle of the slope, rather than measuring the vertical distance.

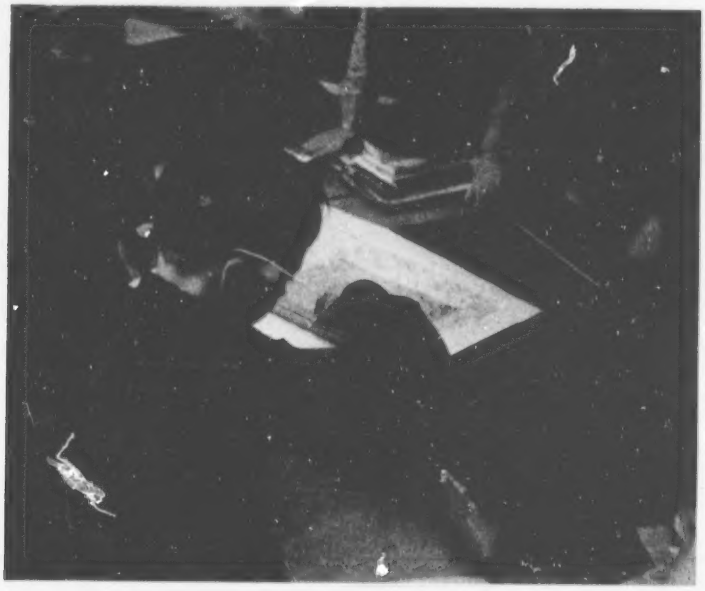
Many children will need help understanding that each string is supposed to indicate a constant elevation. Often their strings will overlap. On commercial maps, however, the only time the contour lines overlap is when they indicate a cliff or an overhang.

Children can try to match their models with photographs taken with a Polaroid camera. Ask the children to look at the photographs carefully and exchange them. Can they find the sand models by reading the photographs?

What clues help you match the sand models and photographs?
Can you "read" your pictures?
If you went on a hike on your model, how would you travel if you wanted an easy trip? A difficult trip? A long trip? A short trip?

Suggest that the children try making models of some of the following:
volcano
gravel pit
cone
hemisphere
lake with an island
pyramid
things they make up





Some may be able to draw contour lines on maps for these without using a model. (This may be difficult for some, since they will have to take into account the scale for both distance and height.) Then they can:

1. Give the drawings to other children to see if they can either figure out the shape or build it.
2. Build the models in sand to scale from the drawings.

A few children may want to make a sand model from a map of a real landscape.

Can you transfer the map to a sand model of the area?

What are the difficulties in building a model from a map? What can you do to make it easier?

"Use a grid."

"Put the contour lines on the model."

"Draw the map on tracing paper so you can see through it. Then you can just hold it over the box and build under it, and you don't have to measure anything."